SAE JOURNAL

DECEMBER
1953

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PUBLISHED BY THE SOCIETY OF AUTOMOTIVE ENGINEERS

A syllogism*...

1 Cylinders wear most at the TOP

2 Chrome plated rings retard wear

3 Therefore, TOP rings must be chrome plated to retard cylinder wear

IT'S LOGIC LIKE THIS THAT HAS CONVERTED 27 LEADING ENGINE MANUFACTURERS TO CHROME PLATED TOP RINGS...

●

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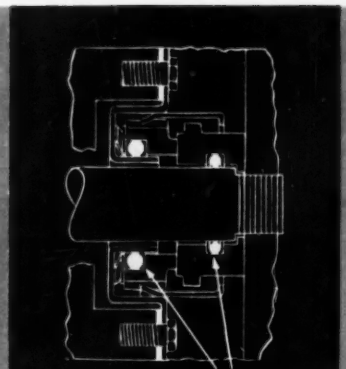
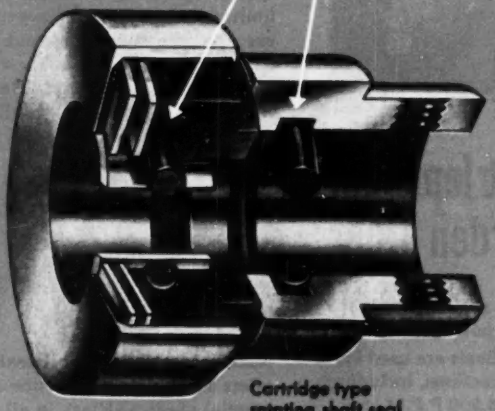
Precision "O" Rings assure



Drawing employing 2 Precision "O" Rings in a typical Cartriseal Unit

proper cushioning, perfect performance, positive sealing for CARTRISEAL UNITS



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Sealing News & Tips

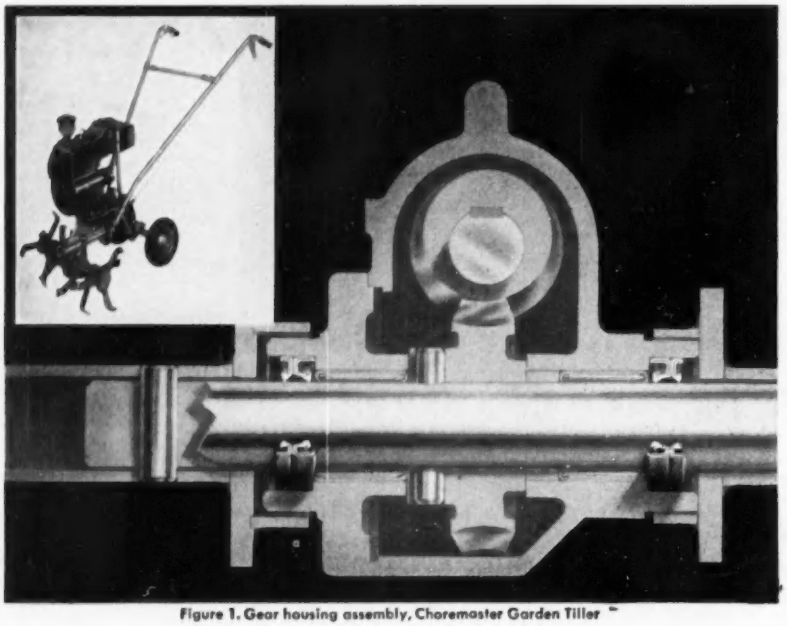

Figure 1. Gear housing assembly, Choremaster Garden Tiller

How National Syntech* Oil Seals halt leakage, exclude dirt from Choremaster Garden Tiller

In the Choremaster Garden Tiller, tines are driven and the machine propelled through a worm gear assembly at the front of the unit. Dirt, dust and mud pack heavily around this forward gear box (Figure 1), making it difficult to achieve 100% exclusion of foreign matter and zero leakage of lubricant without unacceptable loss of power.

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340,000 Syntech

350,000 Syntech

*T. M. Reg.

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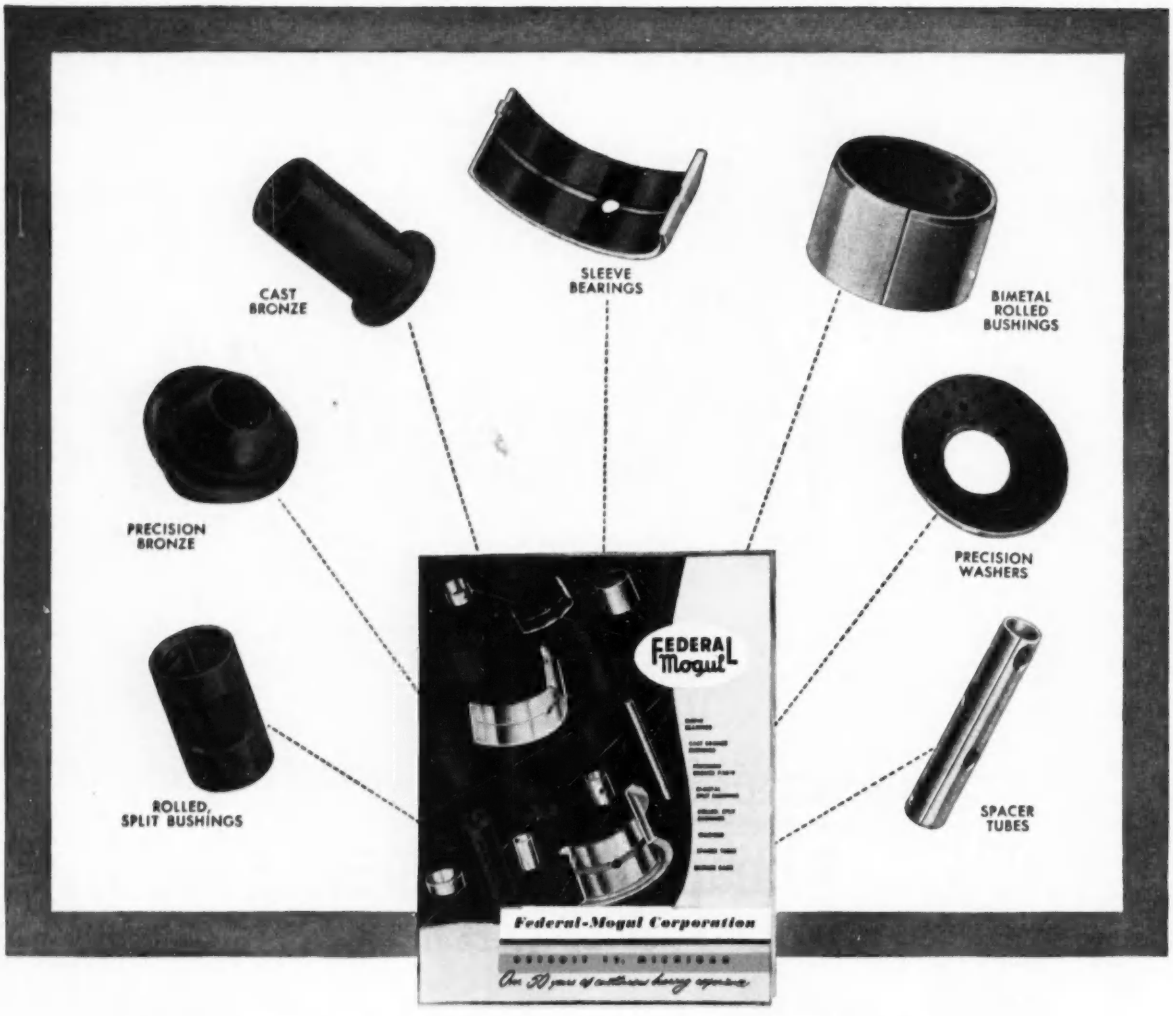

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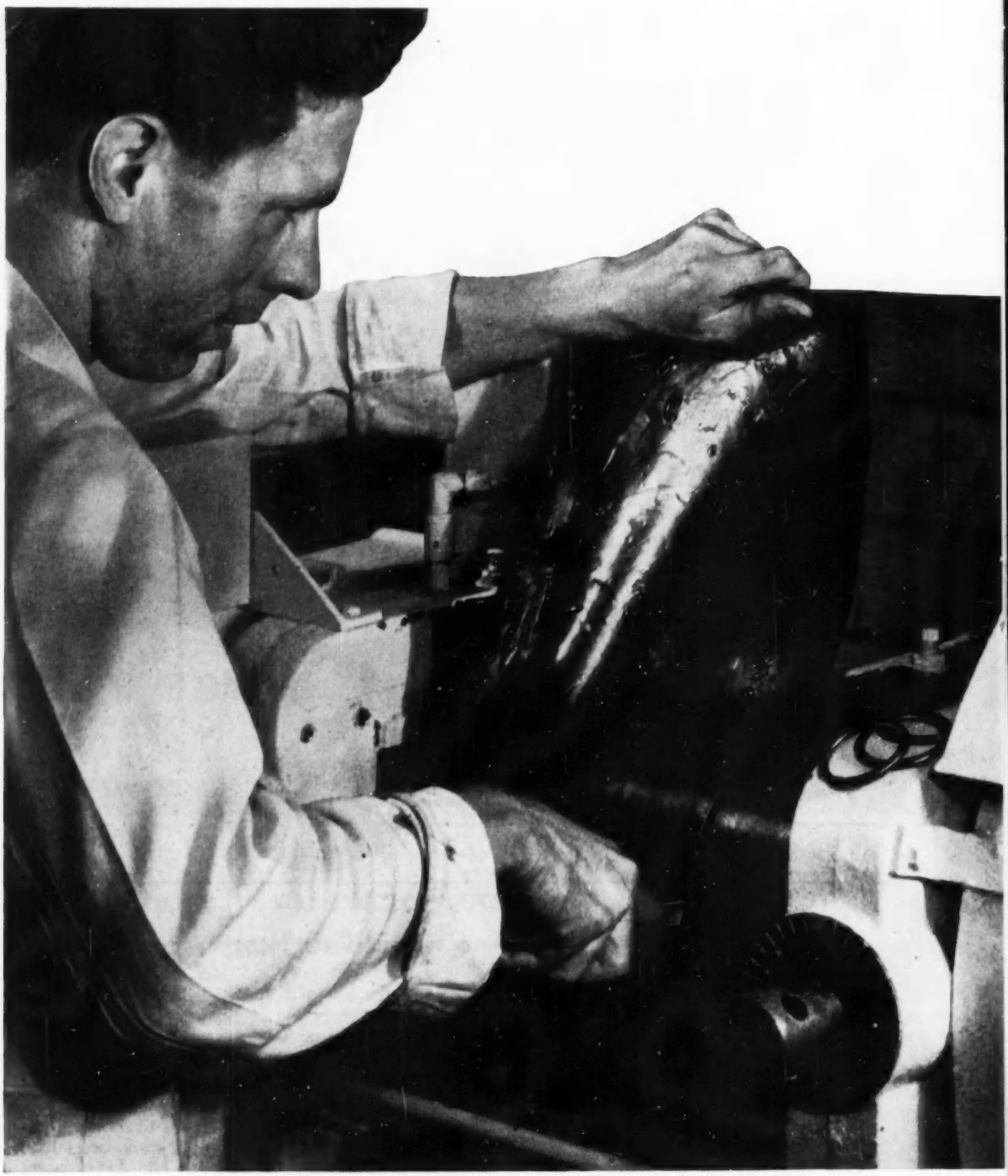
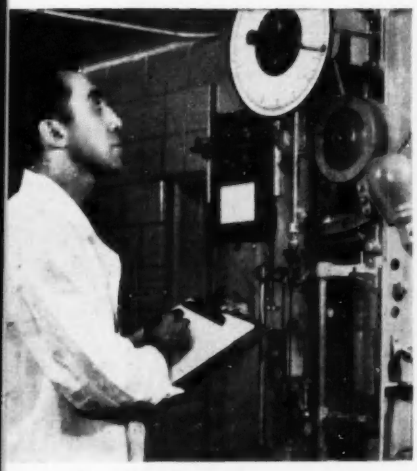
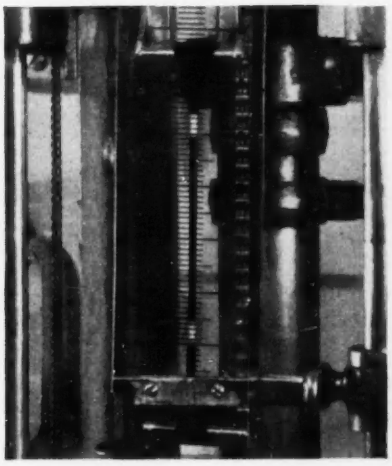


1. Over 800 Parker compounds have been developed to meet your individual O-ring and custom-molded rubber requirements. Just *any* compound won't do the job. Parker checks your specifications to see which compound is best. If none do the job, we'll formulate and mix (shown above) a special compound to solve your individual problem.

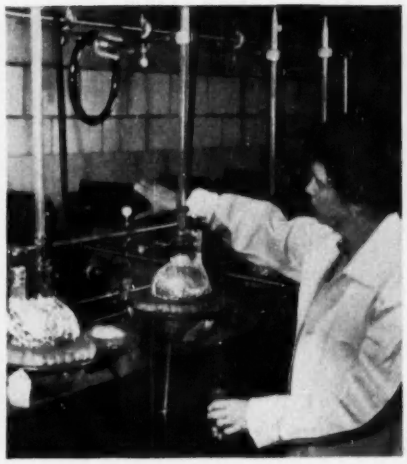
Look how Parker makes sure you get the right O-ring for each specific application



2. Tensile strength is one of the many specifications that each Parker O-ring compound must pass. Other tests prove resistance to both tear and abrasion.



3. Elongation, being tested here, and maximum compression set are other vital factors that determine which compound will assure leakproof O-rings for your application.



4. Fluid and temperature tests help assure long life of Parker O-rings. Compounds are checked for resistance to oil, fuel, or chemicals at high or low temperatures.

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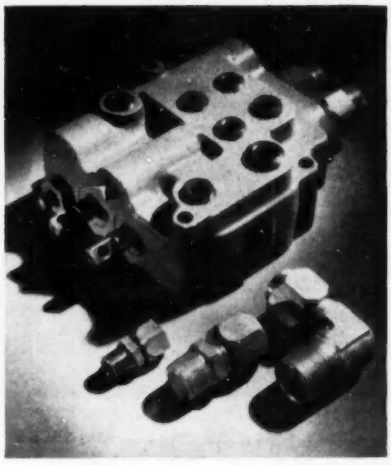

6. What other Parker products for hydraulic and fluid systems interest you? Triple-lok flare tube fittings? Ferulok flareless fittings? New hydraulic directional control valves?

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	S.C.	.015 or .020 steel
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	C.F.	.060-.065 CP corbestos .0094 steel flange
	S.O.	.0094 steel top .060-.065 asbestos layer .0094 steel bottom
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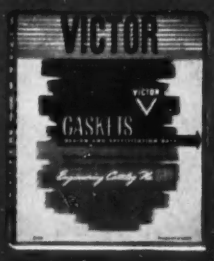
COMPARATIVE RATINGS of 18 most commonly used head gasket structures, based on blow-by and burn-out factors.



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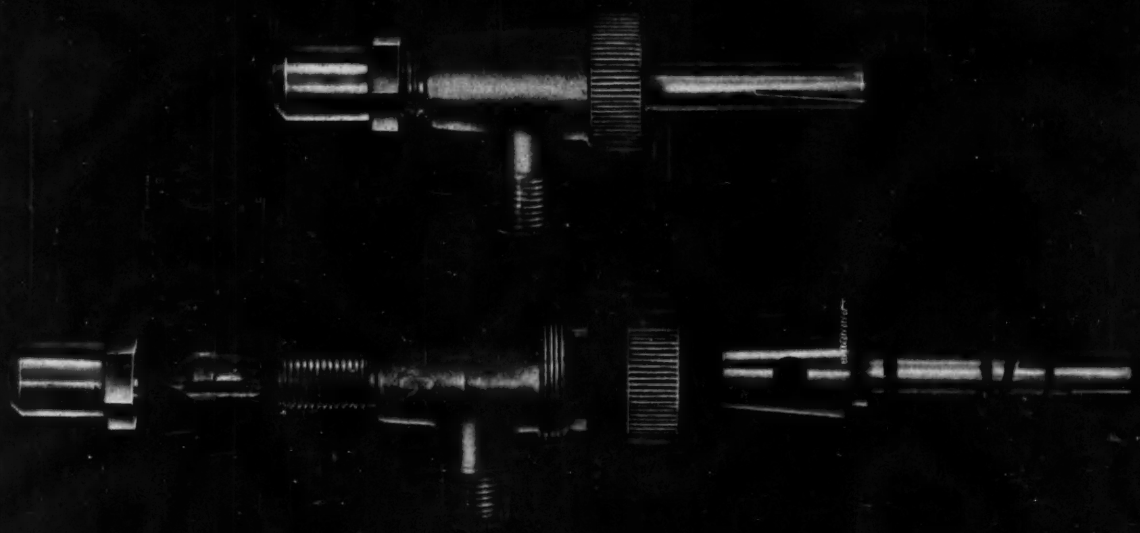

Kitchen range burner valve by Lincoln Brass Works, Inc., Detroit 16, Mich. Two different brasses are used in this valve, which is entirely of brass except for the washer and spring. Lincoln also makes valves for heaters and furnaces; flow, drain and shut-off valves for gasoline lines; shut-off valves for agricultural sprayers, and a wide variety of tube and pipe fittings, all entirely or chiefly of free-cutting brass rod and free-machining brass forgings.

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For the Sake of Argument

Habit . . .

By Norman G. Shidle

Most of us would be further along if we spent more time getting into habits and less trying to get out of them.

The very word "habit" has come to have a slightly unsavory connotation. We tend to be apologetic about having one. Ten people are trying to get rid of some bad habit for every one who is busy trying to establish a good one.

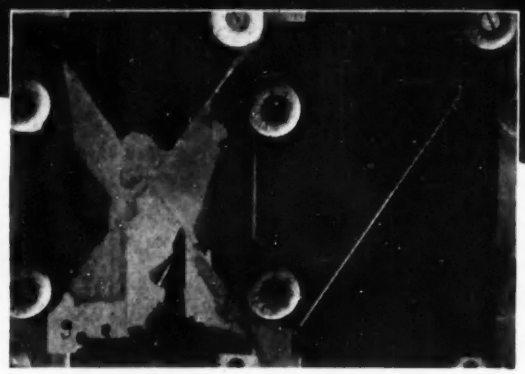
Getting good habits is more rewarding than ousting old ones if only because it focuses minds on constructive pursuits. Getting a good habit betters something already good. Spend enough time that way and the bad habits often vanish automatically. Make a habit of being on time—and that old habit of arriving late no longer exists. Make a habit of speaking pleasantly to everyone—and that old habit of growling ceases to exist. Start giving the other fellow more than half the road—and that old habit of crowding other cars becomes a nothingness.

Habit can be a vital, constructive force. It can take care of hundreds of daily decisions. It has to—or we'd have time for nothing but trivialities. The best way to get freedom to do what we really like to do is to put more actions under such automatic control that we don't have to spend time discussing them. "What a waste of time and energy," Dr. Ralph Sockman said the other day, "if we men debated every morning with ourselves whether we should shave or what train we would catch to business! Such things we reduce to fixed habits and thus free our minds for bigger choices."

Instead of apologizing for our habits, we had better get habits which need no apologizing for. "Mind the Light" is a more productive motto than "Avoid the Darkness."

Parker Rust Proof Company's corrosion test field at Morenci, Michigan.

Birds-eye view of a strange crop



What weather does to finishes! Panel left, paint over untreated aluminum. Panel right, paint over Bonderite-treated aluminum. 11 months outdoor exposure.

A crop of 6,400 metal panels is tended in Parker Rust Proof's outdoor test field. The harvest is facts on the durability of various finishes over various metals.

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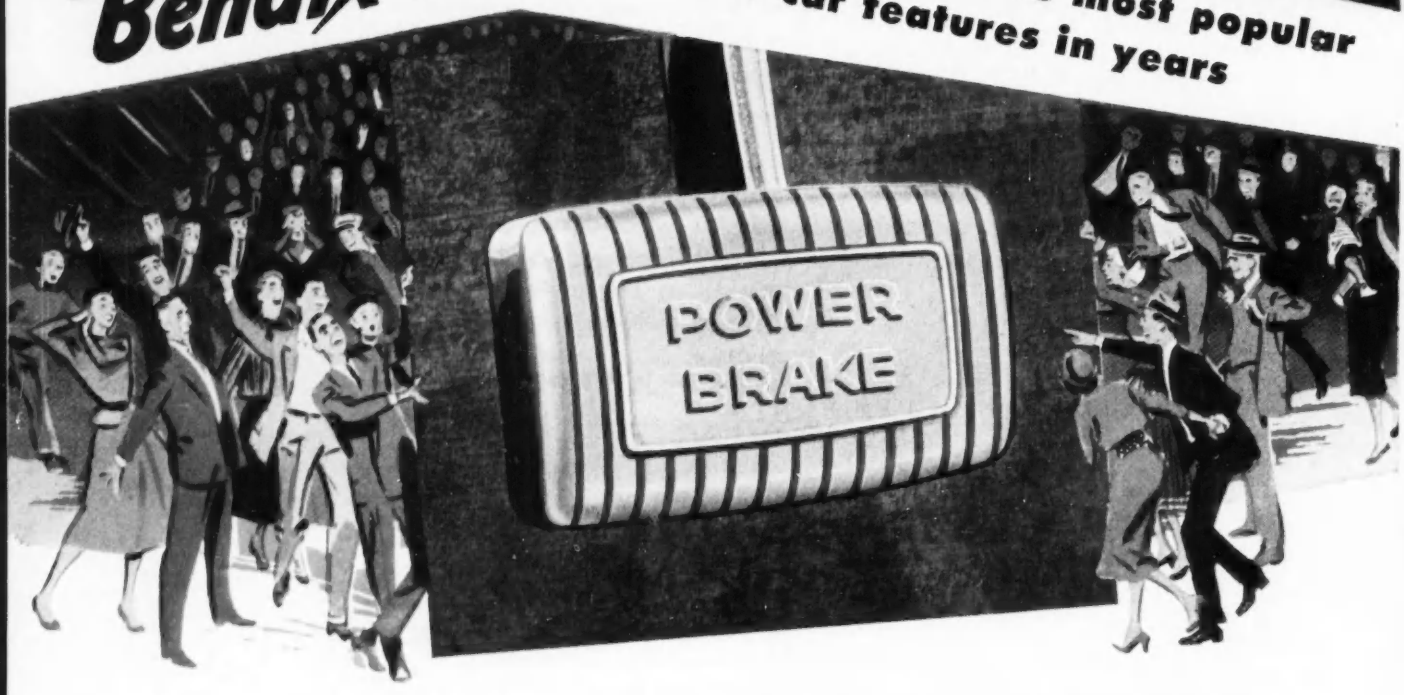
Bendix Low Pedal Power Brake

one of the most popular new car features in years



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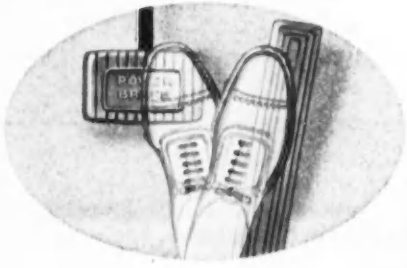
NOW *Stopping* IS AS EASY AS *accelerating*



It is no longer necessary to lift the foot and exert leg power pressure to bring your car to a stop. With the Bendix Low Pedal Power Brake on about the same level as the accelerator, an easy ankle movement, much like working the accelerator, is all the physical effort required for braking. And by merely pivoting the foot on the heel, shifts from "go" to "stop" controls are made in far less time.

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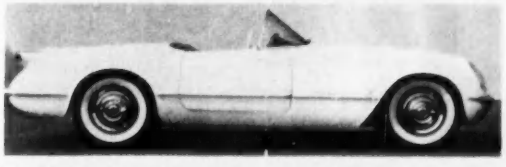
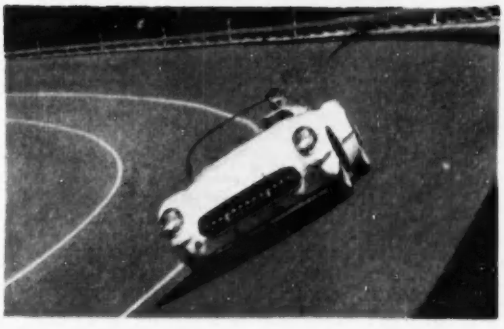
The Chevrolet Corvette Makes Its Debut





Maurice Olley

Chevrolet Motor Division, General Motors Corp.

Based on paper "The Evolution of a Sports Car—the Chevrolet Corvette" presented at a meeting of SAE Detroit Section, Detroit, Oct. 5, 1953.

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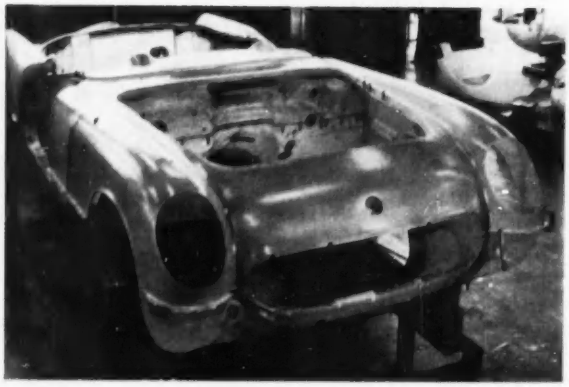
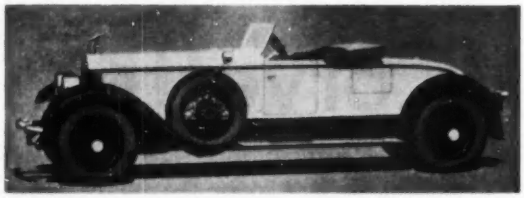
The Corvette—Its Body



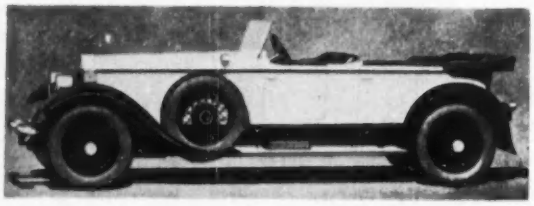
BODY MATERIAL of the Corvette is glass-reinforced plastic. The complete body with its laminar construction of glass fibers impregnated and bonded by plastic weighs only 411 lb. Besides its light weight, this type of body material will stand a lot of abuse, will not rust, will not crumple in collison, will take a paint finish, and is relatively free from drumming noise. It is somewhat expensive, however, costing a little less than a dollar a pound.

Evolution of a Sports Car

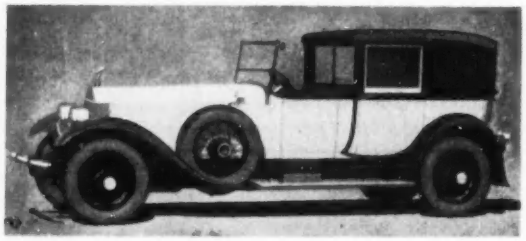
1. First came the horseless carriage, innocent of weather protection, little more than a mechanical toy, and a foretaste of joys to come.



3. But the touring car did not please the antisocial tendencies of the young, always desperate to escape the chiding voices of their elders in the rear seat. The roadster seemed the answer. If the folks came along, they had to ride in the rumble seat—without weather protection or means of communication.



2. Then the touring car put in an appearance. For years this appeared the complete solution to the problem, combining the open air with adequate weather protection and adequate space.



4. After World War I, the fashionable thing was a town car that had the driver out in the open, and the passengers completely enclosed beneath a leather hood, with no side windows, and only a small spy hole at the back.

PHYSICAL PROPERTIES—A glass-reinforced-plastic body panel has approximately the same stiffness as a steel panel that weighs twice as much. (Thickness ratio: 3 to 1.) Reinforced-plastic structural members, in which stiffness depends on the first power of the thickness rather than the cube, are not equally desirable. They are much more flexible than corresponding metal structure and require various forms of reinforcement.

PHYSICAL PROPERTIES OF FIBERGLAS

Tension Modulus obtained by flexure	1 to 1 ½ x 10^6
Steel	29 x 10^6
Shear Modulus obtained by torsion	.25 to .3 x 10^6
Steel	11.5 x 10^6
Weight per cubic inch Fiberglas	.05 lb.
Steel	.283 lb.
Max. usable tension stress (approx.)	17000 psi.
Max. usable shear stress (approx.)	10000 psi.

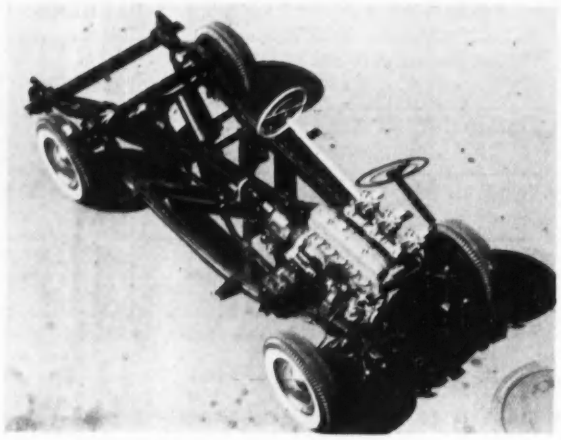
Continued on next page

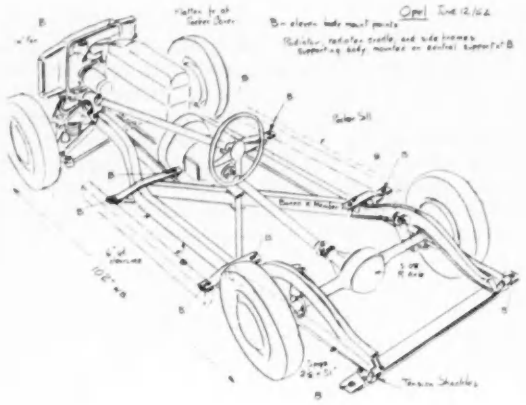
5. Following this, a "closed" car was supposed to appear as little closed as possible. This might be attributed to the influence of the ladies and their genius for appearing uncovered even when they are covered.

6. But the eternal discontent of the young came into the picture again, demanding a car which could be opened to the weather. Thus the convertible became popular. This was a return to the touring car with modern refinements, but with the relatively snappy performance and light weight gone.

7. The next logical step is, as before, the roadster—or what we now call the sports car. Built small, low, and light, without even a pretense of rear passenger accommodation, it is meant to be fun to drive.

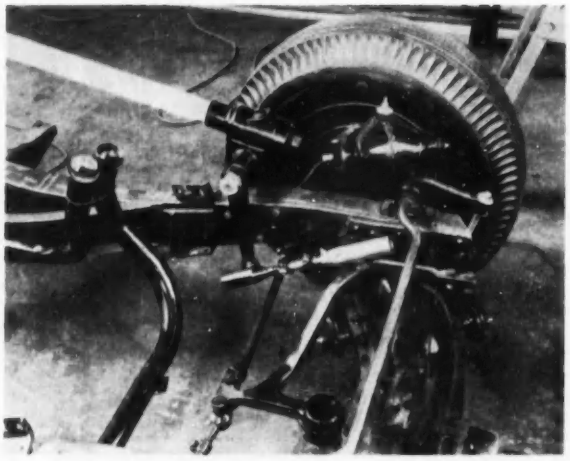
The Corvette—Its Chassis

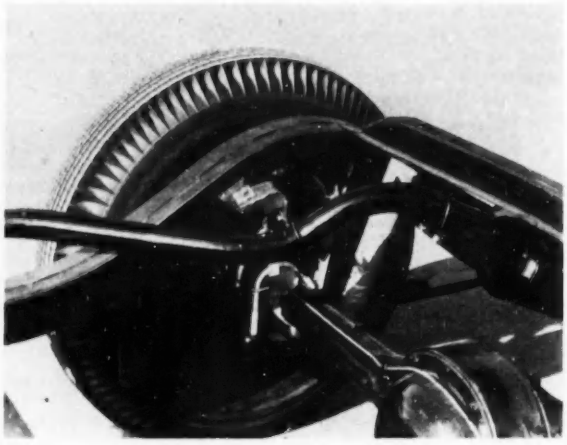




CHASSIS of the Corvette was relatively simple to evolve, compared with development of the "plastic" body. Using components of known reliability, the job was to produce a sports car with adequate performance, a comfortable ride, and stable handling qualities.

CHASSIS COMPONENTS were, in general, adapted from Chevrolet parts. The complete unit weighs 213 lb. The one-piece body is mounted at eleven points to the boxed X-braced chassis. Compared with the standard passenger car, the engine is 7 in. further back and 3 in. lower.

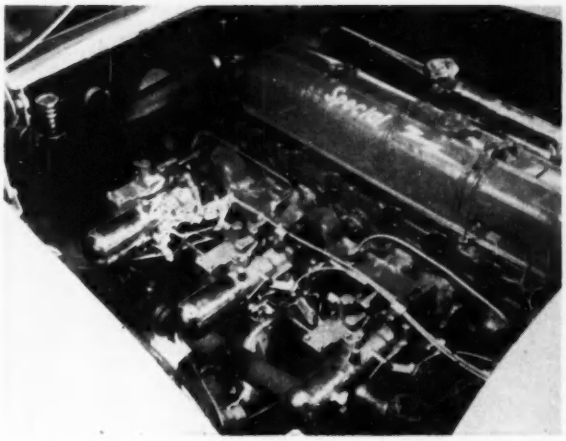




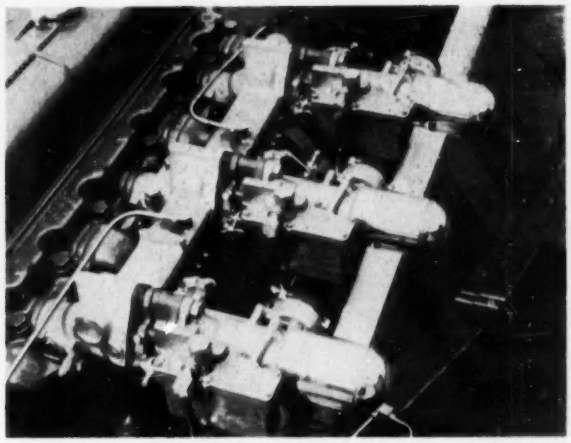
FRONT SUSPENSION is pretty much standard. It is, however, stiffer than normal and is fitted with a fairly stiff front stabilizer. Because of the low engine, the steering center lever was redesigned and mounted on a double-row ball bearing below the front of the oil pan. The 17¼ in. steering wheel is set at an angle of 13 deg from the vertical. Steering gear ratio is 16 to 1; turning radius 19 ft.

REAR SUSPENSION is a simple adaptation of the existing Chevrolet rear axle to a hotchkiss drive, using 2×51 in. leaf springs. The rear springs are inclined to give about 15% roll understeer. (This may appear excessive, but some handling qualities of a car depend on the amount it is allowed to roll on turns.) Rebound straps prevent excessive joint angles in a propeller shaft only 36 in. long.

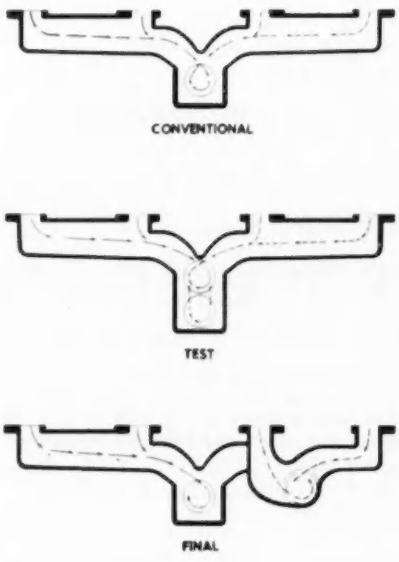
Its Powerplant



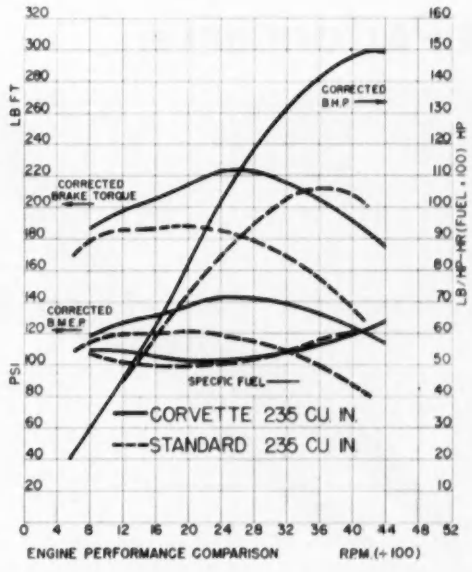
STANDARD CHEVROLET 6-CYL ENGINE (235 cu in.) has been modified to deliver 150 hp at 4200 rpm. Compression ratio is 8 to 1. The high-lift camshaft has metal timing gears. Mechanical tappets and dual valve springs are used. The ignition system is completely shielded since the "plastic" body does not prevent radio interference. A special high-efficiency water pump, driven at 9/10 engine speed, delivers 27 gpm at 2000 rpm.



THREE CARBURETORS supply the siamesed intake ports. To obtain uniform distribution, the three intake headers are interconnected by a small diameter surge pipe. Automatic chokes were tried but did not prove satisfactory because of choke valve flutter and fast idling. Therefore, a manual choke is used. Normal operation is without manifold heat. There is provision for applying exhaust heat in cold-weather operation.



EXHAUST MANIFOLD is dual and of a special type to keep the exhaust gases in the throat of each of the two downpipes always whirling in one direction. (This made it possible to gain some 8 to 10 lb-ft torque in the midspeed range.) The two exhaust systems are completely separate.



ENGINE PERFORMANCE—The engine delivers 150 hp at 4200 rpm, with specific fuel consumption (of premium fuel) no greater than standard. At 4800 rpm, the car with its 3.55 to 1 axle ratio has a conservative top speed of 108 mph.

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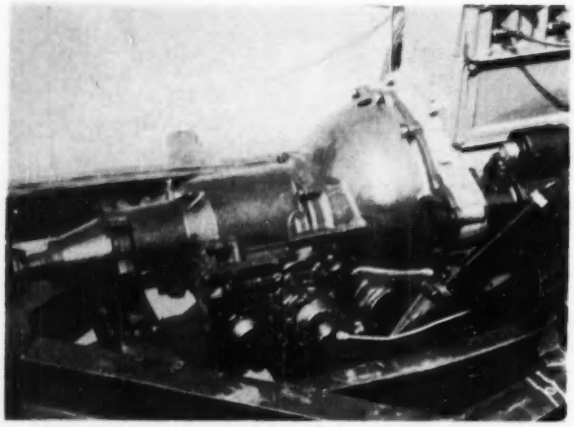
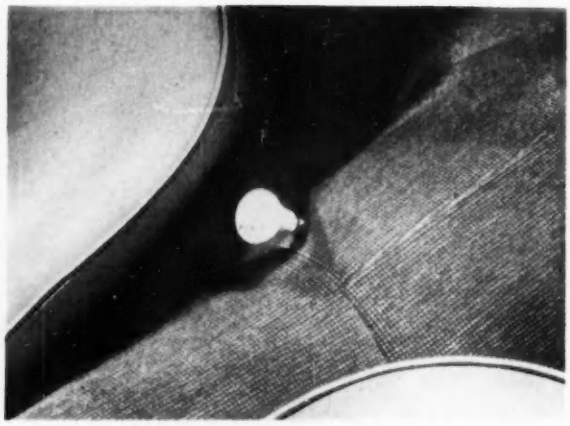
The Corvette—Its Transmission

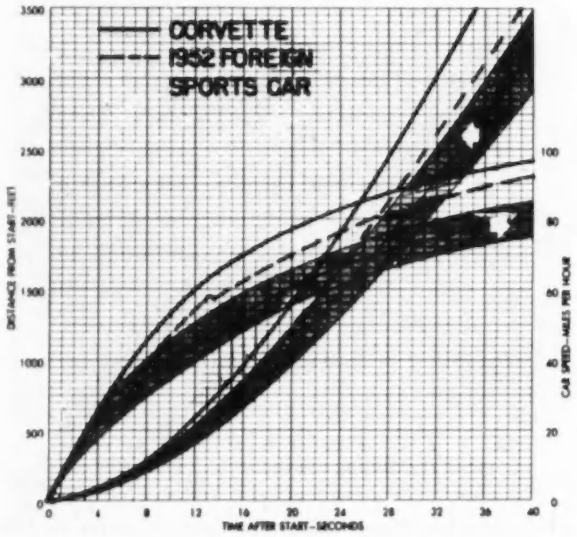


MODIFIED POWERGLIDE best describes the Corvette transmission. Oil pressure has been increased to handle 223 lb-ft of torque; a shifter valve gives a full-throttle upshift at 4500 rpm or 55 mph, and full-throttle downshift up to 47 mph. It also has been modified for the hotchkiss drive. No transmission oil cooler is required.



MOST ORIGINAL THING about the Corvette's automatic transmission is that the control lever has been taken off the steering column (where it obscures the instruments). It has been put back where it came from in the first place—directly beneath the driver's right hand, alongside the transmission.

Its Performance



NO APOLOGY need be given for the performance of the Corvette with its automatic transmission, as can be seen from the above comparison with a 1952 foreign sports car.

SPECIFICATIONS AND PERFORMANCE

- Power/weight ratio is 21 lb per hp
- Overall height is 47 in.
- Weight distribution is 53% front, 47% rear, with two passengers and no load in trunk
- Center of gravity is 18 in. from ground
- Ignition system is 6 v
- Brakes dissipate energy at rate of 1.27 hp/sq in. of lining in a crash stop from 60 mph on a dry road

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

FOUNDRY TRENDS

. . . Highlights of steps foundrymen are taking

to pour better castings – materials, methods, and equipment.

John Stirling, Ford Motor Co.

Based on secretary's report of Foundry Panel held as part of the Production Forum of the SAE National Production Meeting, Cleveland, March 25, 1953. Panel leader was E. C. Jeter, Ford Motor Co.

Shell Molding: It Won't Preempt the Foundry

There is a place for shell molding, but its use is limited. Generally speaking, it will not revolutionize the casting industry.

When a good finish is required, shell molding can be practical. However, when compared economically with castings in which finish is not important there is no advantage to shell molding.

In the aluminum, gray iron, and steel casting foundries it is generally thought that it is not practical for use at this time because of the economic factors. It is true in each foundry that pattern equipment costs are very high and that high volume production is required. Conversion costs make it unfeasible. Consequently, the use of present methods and equipment is desirable.

The malleable foundry has had experiences somewhat similar to the above mentioned foundries, namely, that there are possibilities—two advantages to shell molding. One is the finish which you can attain, and the other is the close tolerances that can be held. However, there are expansion and contraction variations each time. When material shrinks differently from one day to the next, holding to close tolerances becomes a remote possibility. Then you can not hold close tolerances even with the mold.

As regards manufacturing camshafts by means of a shell molding process, it cuts down the amount of finish. However, as we all know, camshafts have been successfully made with green sand molds for

a number of years. With regard to the green sand, the biggest problem was not so much the finish on the camshaft, but the fact that it would warp and did not lend itself to straightening too well.

In the production of the camshaft, as has been determined by foundrymen in the production of other parts, if green sand is given proper consideration—or at least as much consideration as the shell molding process receives, a finish just as good or better can be made. Shell molding has provided good finish, but not any better and in some instances not as good, and they too have the warping problem. Therefore, in summary, camshafts would be a doubtful application for shell molding, although some success has been achieved.

It is important to note that the shell molding technique has had a good influence on the foundry industry as a whole. This influence has been generated by the fact that foundrymen have been forced to check the complacency with which they viewed their old methods. The threat of a new method has created a definite interest in improving techniques. Private research organizations have gone into this to a considerable degree.

By means of our experiments we have acquired a scientific approach to our foundry problems. The result has been that we were able to pool together not only the research that has been conducted recently, but the facts determined in past observation. From that we have gathered data that has disproved several old techniques.

Where before, we thought that pouring temperature, permeability, composition, and other factors had something to do with the workability of the materials at hand, now we have been able to disprove it.

In regard to the uniformity of hardness in shell molding of casting as contrasted to sand casting, particularly in the larger work of gray iron and steel casting foundries, we would say this: "If as much attention were paid to your green sand, hardness, and so forth, you would get just as good a finish and get away from penetration as well as you would with shell molding." Hardness is determined by the cooling technique rather than the molding. This differential in uniformity of hardness is still the same.

On a job wherein the amount of machining is the same on a shell casting as would be required with a sand mold casting, the extra cost of shell molding becomes considerable. In the case of certain alloys, you could definitely show an economic advantage by whatever amount of finish you were able to cut down. But in the casting of a camshaft where you might improve the machine stock, we think it would be of doubtful value.

Steel Castings: Getting Less Complex

In addition to emphasizing the use of the present molding materials, there is a definite trend in the steel casting foundry to make castings which are smaller and less complex then formerly.

For example, in the last five years at least six open hearth foundries have put in weld fabricating shops. By so doing they are able to work with the customer to break up the one-piece casting design. They then put the pieces back together by welding on plates. No longer is it an industry characterized by craftsmen.

The approach, today, is more from the engineering standpoint. Steel castings are as readily weldable as plate, and in some respects more weldable. This practice has been probably the greatest single change in the foundry industry within the last five years.

With the development of better molding and core materials in the casting industry, there is a definite trend toward thinner minimum wall thicknesses in steel castings. Also, better melting procedures permit us to pour at higher heats and the trend toward thinner walls has been accelerated by improvements in weld repairing.

Foundry Personnel: More Needed

The problem of hiring personnel in the foundry industry is an important one. Employees of the foundry work under mental stresses and strains—sometimes racial tension to some degree. It is necessary that foremen and the men under them develop as complete an understanding between themselves as possible. The supply of men who are interested in working in the foundry industry is limited due to conditions which have existed in the older established foundries, such as adverse atmospheric conditions.

As a result of the limited supply, there is a defi-

Foundry Specialists . . .

. . . who led the discussion in which the material for this article was developed were:

E. C. Jeter, Leader
Plant Manager
Ford Motor Co.

John Stirling, Secretary
Supervisor of Training Section
Ford Motor Co.

Alex Barczak
Works Manager
Superior Foundry, Inc.

F. J. Pfarr
Plant Manager
Lake City Malleable Co.

Al Hinton
Plant Manager, Cleveland Sand Foundry
Aluminum Co. of America

William Phillips
Sales Manager
Crucible Steel Casting Co.

Frank O'Malley
Personnel Director
Ferro Machinery & Foundry, Inc.

nite personnel problem of double employment, wherein employees of one company have sought and found employment with another company on either a part-time or full-time basis.

Another form of personnel problem is the employee who, having worked in foundries for several years, finds employment with a new company. Certain developments indicate the presence of an occupational disease which possibly was developed in previous years. Giving physical examinations and having a good medical and health program in general will do a great deal toward solving this type of problem.

Much emphasis has been placed upon an educational program for foundrymen. This activity has been sponsored primarily by the Foundry Educational Foundation. The foundries are employing engineering students into their industry and are endeavoring to raise the level of the foundry to a relatively high degree.

The appeal from foundrymen is being made to senior students and even to the junior high school level in an attempt to develop an interest in the foundry and its operations. Some schools are putting into their curriculum courses pertaining to foundry operations such as pattern making, and thus are cooperating with the management to a considerable degree.

Testing Castings: Nondestructive or Destructive?

The problem of testing castings in the different types of foundries revolves around the use of destructive and/or nondestructive media.

In the aluminum foundry it is general practice to use nondestructive tests as much as humanly possible. After the essential elements have been determined such as gating procedure, pouring temperature, and so forth, the first group of castings is automatically x-rayed. This is continued at all times until we get out of trouble on a given job. This x-ray interpretation, however, is a very vital point.

It is generally believed that the old fashioned idea of taking machine cuts is quite advisable. The machine cuts are often times taken off and a comparison made with the x-ray.

In general, destructive testing methods in the aluminum foundry are generally restricted or confined to scrap castings. However, an important factor in the determination of methods is the nature of the work performed.

For example, in a noncaptive shop, dealing with the general customer, it is often the case that the foundry may make 10 castings on order or 10,000 castings on order. Some are highly alloyed metal jobs, others not. Some are complicated core work jobs, others not.

Consequently, when high alloys or complicated cores are involved, or large orders, destructive testing would be resorted to assure success in the ulti-

mate run. In many instances, sample jobs are sent to the customer and it is insisted that they be run through the machine lines for testing purposes before the rest of the order is completed.

Along with the development of jobs within the plant, as they flow through the departments, records are carefully catalogued for future reference. Such plants might run a 30 to 40% change in the parts made on a daily basis. One gray iron foundry x-rayed cylinder heads and it was found to be of great advantage to use x-rays in general in the gray iron foundry.

Magnetic testing has been used extensively in the steel casting industry. However, it is not used 100% on every sample testing. Interpreting x-ray is a very difficult problem for a commercial job, although it is used probably more in the steel casting industry than in most foundries. A correlation between the result of the x-ray films and the actual service should be developed. Case Institute is working on such correlation currently.

The malleable foundry industry does not use the x-ray to any great extent. However, the problem there is different. After a malleable casting is made, a heat treatment operation is necessary. This may last from 48 hours to one week. So a definite assurance is necessary to determine that when the castings are made they are internally correct. Therefore, when starting a new job, we utilize destructive testing very much. Normally, testing in a malleable industry is destructive. Magnaflux is used to a certain extent.

Vacuum Process: Still in Experimental Stage

Experiments to test the value of a vacuum process in pouring castings has indicated that it reduces internal pressure.

In such tests it was determined that the permeability of the original sand would have to be very low.

The tests have indicated no appreciable change in the amount of yield possible.

The size of the casting used in testing vacuum was limited to a maximum of about 250 lb. In that instance it happened to be a freight car casting.

It is predicted that the use of vacuum in the molding process would increase the cost of castings.

In the testing of vacuum as conducted in the testing institute, attempts were made to pull a partial vacuum instead of a complete vacuum. At this time it has not been made generally known as to how far they went with this phase of the experiment. However, it has not raised too much interest commercially.

In the experiment, no internal pressure problem was found using the simple effective rig which they had. However, it cost over $300,000 to get the first one poured.

There is a great deal of experimental work being performed in consideration of the rate of cooling within the mold in regard to vacuum molding. No one has found out how to control production work along this line.

For Hydraulic Valves: Gray Iron or Malleable?

In using gray iron to produce hydraulic valves, we are not so much concerned with design as we are with the structure of the iron itself. We are quite a bit concerned with shrinkage and probably the greatest complication is the core work involved in the section.

It is generally good practice to work with an engineer in any concern to try and design a valve which will keep the passages open. Wall sections in valves of this type would be in the neighborhood of ½ in.

In one particular case involving a three-ton room cooler, we have to make about six different designs. They have high and low sides with quite a wall between them. It is in cases like this where you have to watch the amount of pressure with which you would expect to work.

Our alloyed castings in the gray iron foundry very seldom rupture under 2000 psi pressure. You have to work very carefully with blending of sections or you will get into "weepers." Anything up to 250 psi pressure will not alarm the gray iron foundryman; but when you get into the neighborhood of thousands, you do give him considerable cause for concern.

Gray iron foundries generally can and do produce

wall thicknesses of less degree than malleable shops. The malleable foundries, however, have made wall thicknesses up to ⅜ to ½ in. Under that the malleable foundries have not made any. Malleable foundries would have more shrinkage concern than the gray iron. Therefore, there is a definite feeding problem in the manufacture of hydraulic valves by the malleable foundry industry.

Plaster Molds: When to Use Them

In the aluminum industry there are two uses for plaster in the molding technique. One, to make the entire mold from plaster. Two, to use plaster in conjunction with other molding processes—green sand, dry sand, etc. It depends upon what you are seeking.

The principal advantages of plaster are (1) accuracy; and (2) finish—which eliminates machining operations. In general, use a plaster mold where you need accuracy and finish and use permanent molds or green sand to give strength of casting.

The plaster mold does not require the expense of pattern equipment as required by shell molding. It is basically a case of accurate pattern preparation. The use of quickly built, inaccurate patterns has created problems in the field. The use of plaster molding offers a good opportunity for people to test castings which require accuracy and finish at a more economical rate than to use a permanent mold or some form of shell mold.

In the use of plaster molds, the faster the casting is poured the better. That is to say, you have all the diseases that go with sand. However, it is not necessary to vent plaster molds.

Coining: A Trend in Secondary Operations

There is a definite tendency in the malleable foundry industry to perform secondary operations such as coining. The function of coining, to eliminate machining by the customer, is one of the better selling points for the malleable foundry industry. It is a job that can be done if proper equipment is available.

Coining provides a casting which the customer can put into operation with very little machining. By casting surfaces without finishes, we have definite locating points by which to check castings for proper machining.

Insofar as the malleable foundry industry is concerned, it will be essential that the trend to the performance of secondary operations be continued to the extent where foundries have their own presses as regular equipment.

Small brake shoes with a maximum size of 10 to 12 in. are being coined at the present time in the malleable foundry with no finish at all. Linings are cemented to the castings and both are tested to assure true diameter. How long it will be before larger presses are installed to coin larger products, such as 20-in. brake shoes, for example, would depend upon the existence of repeated orders and high volume production requirements. In other words, the trend of the malleable industry to the larger presses will revolve around the economic factors.

A choice between the use of a flat die or a forging die is worthy of consideration. Such consideration also revolves around the economic factors. If the order were large enough to warrant the expense, flat dies would not be used and dies that are composed of a number of wedge-shaped dies would be feasible. Coining of steel castings is practical occasionally. However, more coining is not performed because of the lack of volume which again implies the influence of economic factors.

Generally speaking, the trend in the malleable field is the reduction of finish to a point of no finish at all or just grinding. This change in attitude on the part of the malleable foundryman is a reflection of change in attitude of the buyer who is being influenced by the engineer.

The foundryman no longer can think in terms of selling castings by the pound or by the ton, but must condition his mind to the production of end products. In other words, it is no longer a casting, but a wheel or a bracket or some other specific product.

(The report on which this article is based is available in full in multilithographed form together with reports of seven other panel sessions of the 1953 SAE Production Forum held at the SAE National Production Meeting, Cleveland, March 25. This publication, SP-301, is available from the SAE Special Publications Department. Price: $2.00 to members, $4.00 to nonmembers.)

What We Know about

Stress-Corrosion Cracks

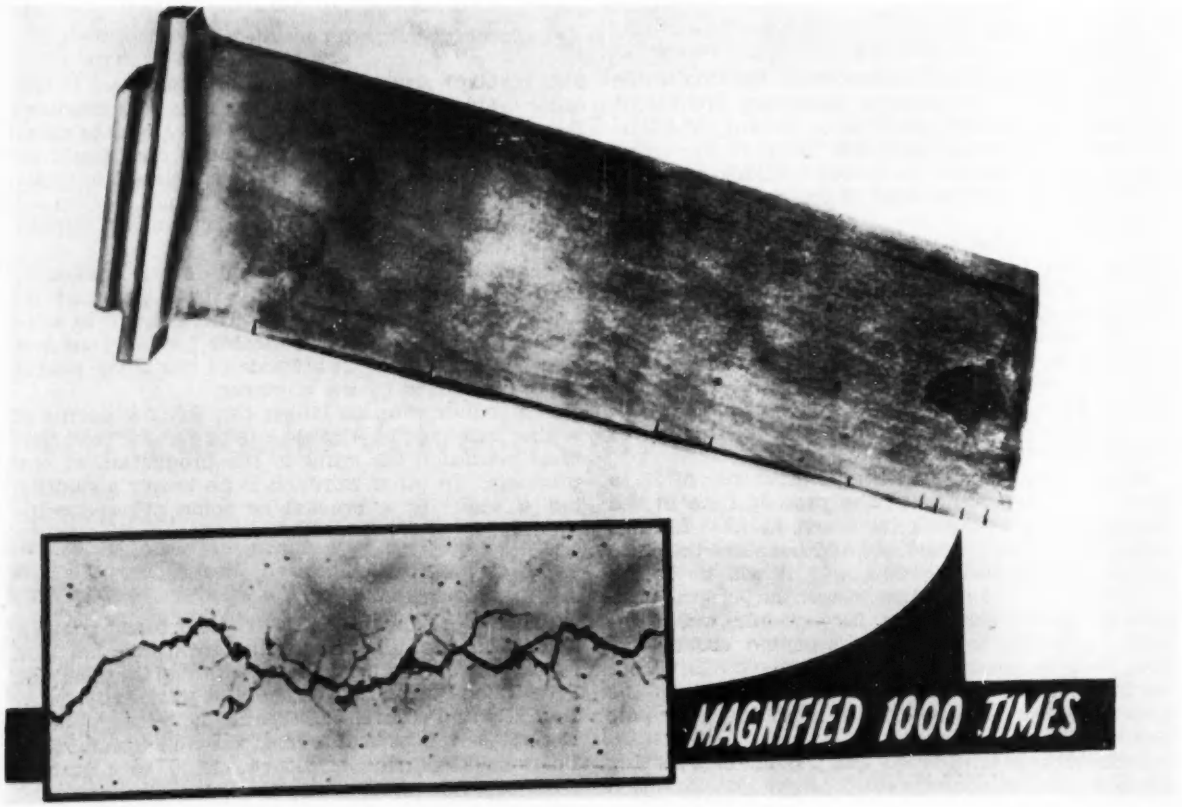
COMPRESSOR blades suffer characteristic cracks that apparently are due to a combination of corrosion and residual stresses. This problem however can be controlled by proper heat treatment.

Early in the gas turbine business, magnetic-particle inspection disclosed cracks up to 1/8 in. long in compressor blades of 12% chromium stainless steel that had operated for relatively short periods. Fig. 1 shows such a crack. The cracks were at approximately right angles to the blade edge. In some cases they did not come all the way to the edge.

Examination under the microscope showed that the cracks were intergranular and that they were associated with a small amount of surface corrosion. Selective etching revealed some localized over-heating at the blade edges and a cross-sectional hardness differential.

After a great deal of trial and error, General Electric engineers found a way to reproduce similar cracks in accelerated tests. Blades with a high re-

Fig. 1



In Compressor Blades

R. B. Johnson, Jr., Evendale Plant Laboratory, General Electric Co.

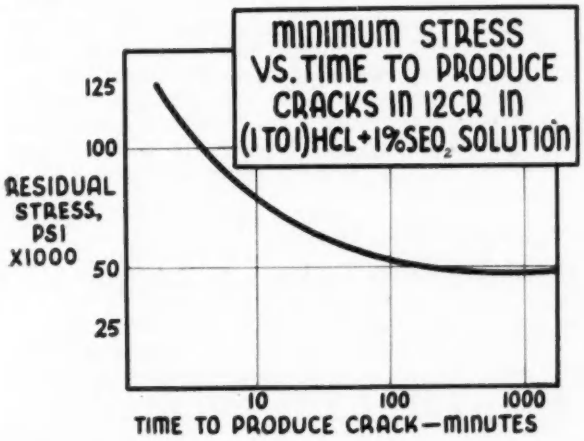
Based on paper "Jet Engine Metallurgy" presented at the SAE Detroit Section Meeting, Feb. 2, 1953.

sidual stress at the blade edges were cracked by subjecting them to a selective corroding solution. The conditions necessary for producing these cracks fit the descriptive term "stress corrosion."

It was theorized that the nascent hydrogen atom evolved at the blade surface in the corroding solution enters the grain boundary and unites with another hydrogen atom to form a molecule. The molecule exerts a stress that, in conjunction with residual stresses, is sufficient to cause intergranular cracks in the metal.

To study the effect of residual stresses, strips of 12% chromium steel were bent to various degrees, then subjected to the corroding medium. Fig. 2 shows the results. The experimenters concluded that stress level has to be greater than 50,000 psi to produce cracking. Above this stress level, the higher the stress, the shorter the time for failure; in fact, the relationship is logarithmic.

Fig. 2



Other tests showed that blade hardness influences susceptibility to stress corrosion. Early gas turbine blades had hardnesses well above Rockwell C 30 to insure maximum fatigue strength, but accelerated stress corrosion tests showed that below Rc 30 "stress corrosion" caused no concern. Some fatigue strength is sacrificed, but damping is improved.

The corrosion solution that was adopted as the standard was (1 to 1) HCl and (1%) SeO_2. Although this was an accelerated test, it did reproduce the kind of crack developed in service, and later was set up as a quality control test on production blades to insure that manufacturing procedures were not abusive. The true corroding media in service could well have been the result of a potential established between hard and soft areas in the blade in an electrolyte made up of an alkaline water solution. It was observed that these cracks occurred in the early-stage blades in the compressor —a section where water vapor could easily collect.

To insure against a dangerous level of residual stress in compressor blades, a stress relief anneal was introduced. This anneal reduced the level of stress to a point where the accelerated stress corrosion test did not produce cracks and eliminated service failures of a stress corrosion nature.

(Complete paper on which this abridgment is based discusses also the metallurgy of turbine engine burners, tail cones, afterburners, and turbines. The paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Planning Assembly Lines for Volume

THREE main topics were discussed at this panel, as follows:

1. Problems involved in high-volume production of thousands of pieces per day.
2. Problems involved in lower-volume production of larger parts.
3. Group incentive wage payment as compared with a flat rate plan of payment.

In addition, some general problems encountered in planning and maintaining an assembly line were covered.

Problems Involved in High-Volume Production

Question: What factors determine the spending of money for new equipment for the mechanization of assembly operations?

Answer: A study is made of doing the job by the methods currently being used and is compared to the estimated labor cost of doing the job on a special-purpose machine. If the labor savings are sufficient to pay for the cost of a new machine in a period of twelve to eighteen months serious consideration is given to building the machine.

Question: Are these special-purpose machines designed by an automation department?

Answer: Some manufacturers do have a formal automation department, while others do not. One manufacturer builds these machines using a combination of their tool design department and a special machine building department. This department performs the functions of building the machines, training the people who are to operate them, and also training the tool and maintenance people to do the necessary maintenance work on the machines after they are placed in production. It has been found advisable to make a streamlined design and use some chrome plating to make the machines attractive in design as well as efficient in operation. It has been found that the operators working on an attractive machine take an increased pride in their workmanship and in maintaining a high rate of productivity.

Question: What determines the work speed and the rate of production on a new machine?

Answer: A study is made of the schedules that must be met. The work to be done on the machine is broken down into the task to be assigned to each operator and then a comparison of this breakdown is made with other similar jobs being done on the same type of equipment. From this comparative study the cycle time is determined.

Question: After the machine is built, has it been found necessary to change the quality of parts supplied to the machine?

Answer: In a great many cases it has been necessary to improve the quality and make the parts more uniform in order to feed them efficiently through the machine.

Production

H. G. Riggs, Delco-Remy Division, GMC

Based on secretary's report of Panel on "Progressive Assembly Technique and Methods" held as part of the Production Forum at the SAE National Production Meeting, Cleveland, March 25, 1953. Panel leader was W. L. McCarthy, Delco-Remy Division, GMC

Question: How are operators selected for assignment on new machines and how are they paid?

Answer: In the selection of operators, consideration is given to the ability they have shown in the department, to the adaptability they have shown in learning new work in previous assignments, and to their seniority. They are paid the same assembly rate on the new assignment as they have been receiving on their former job.

Question: How are operators trained on these new machines?

Answer: In the machine building department, one or two men have the assignment of training new people. These men report to the foreman in charge of this department. Their responsibility is to take the operators assigned to the machine, acquaint them with their new jobs, and assist them in every manner in gradually increasing their productivity on the machine until it is operating at its normal cycle time.

Question: After the machine is built, how long does it take to train the operators and bring them up to a normal speed?

Answer: In most cases a period of four to six weeks.

Question: At the beginning of this training period are the machines slowed down in order to begin the training?

Answer: The machines are operated at their normal index time throughout the entire training period. At first the operator will miss some stations on the machine as it indexes, but as they become more familiar with the work they are able to keep the machine loaded.

Question: What happens when this machine is moved from the machine building department into the production department where it is to be permanently located?

Answer: In most cases very little difficulty is experienced since the operator and the tool

people have been trained during the past several weeks as the machine is being "bugged out." Top supervision in the plant must accept a new machine and the interest must come from them. They must follow through on the problem of making better and more uniform parts. It is essential that there be no letdown in the feeling of pride in a new machine on the part of the operators.

Question: How do schedule changes affect these special machines?

Answer: Before any new machine is built it is essential that the engineering department attempt to determine what the future needs of the customers will be. If any design changes are contemplated, provisions for these changes should be built into the machine in order to avoid costly changes at a later date. In the building of these machines a great deal of standardization of the bases and certain other parts has been made in order to provide as much flexibility as possible for future changes.

Problems Involved in Lower-Volume Production

Question: When a single assembly line is used for a wide variety of models, what are the determining factors to be considered in the range of models that may be produced efficiently on this line?

Answer: One manufacturer schedules models on his assembly line that vary as much as 40–50% in the man-hours required. These models are spaced on the line in accordance with the amount of work to be done on them. The number of men assigned to this line is an average for the jobs being built on the line for that particular day. In order to maintain approximately the same number of men on the line from one day to the other a daily schedule of fast and slow assemblies is planned five days in advance. In order to operate this variety of work efficiently the men on the line must help one another on fast and slow jobs in order to keep everyone busy and to keep the line flow going. At times men build subassemblies off the line and at times they will work on the line. The total number of hours of work per day on the line is kept the same from day to day. If good assembly efficiency is to be attained a very thorough scheduling and planning not only of the assembly line but also the component parts departments must be done. In many cases jobs are scheduled from customer orders. Proper lead time for the parts departments must be set up and assemblies scheduled in accordance with this. In this type of manufacture the amount of money tied up in inventory is very often a serious one.

Question: How does each man on the assembly line know what he is to do?

Answer: During a constant schedule each man takes care of certain jobs. The line is rebalanced whenever schedules are changed and work reassignments are made. Each job has a standard set on it. Supervision must know these rates and properly assign work to the men. Extra men should not be kept on the line because of lowered efficiency. One manufacturer feels that quality control has helped his scheduling greatly by reducing rejections and getting a better flow of parts. He feels that quality control is a means of getting pride of workmanship back in the job.

Group Incentive versus Flat Rate

In regard to the group incentive wage payment plan versus the flat rate plan, it was agreed that either method could be used successfully. In either case, well-trained supervision and good employee relations are vitally necessary in order to maintain efficient production.

Question: What are the advantages or disadvantages of piece work as compared to day work?

Answer: It was the general feeling that more supervision is required to maintain a high level of productivity when people are paid on day work and that carelessness may be more prevalent under this plan. In the case of piece work, the operators are more likely to police themselves and maintain their rate of production. However, a great many difficulties arise when new jobs are put into production and when excessive troubles occur on old jobs.

Question: In a plant using the piece-work plan, are the methods established before a job is started?

Answer: In most cases the method of doing a new job is laid out and an estimate is made before the job is started. In some assembly operations there is often a trial and error period before the proper method is established.

Question: How are the operators paid on a piece-work plan when the rate on a new job cannot be made?

Answer: The base rate is paid on a new job while it is being "bugged out." After a short time if it is apparent that the rate cannot be made it is restudied and a proper rate is set. In some plants when the operating conditions are beyond the operator's control an additional allowance is made.

Question: When the group incentive system is used, how are wages determined?

Answer: In one plant approximately one-half of the operator's pay is on a piece-work incentive basis. The other half of their rate is fixed and changes only with base rate changes, cost of living changes, and so forth. In this plant using the group incentive plan each assembly unit has a dollar value. At the end of the day the total dollar value of all the assemblies produced is added up and divided by the man-hours spent in order to determine the premium earned by each man on the group. This premium plus his fixed rate gives his total earnings.

Question: When a group incentive system is used and some of the regular operators are absent, the earnings for the group are reduced. What is done in this case?

Answer: In one plant a crew of people trained for various jobs is maintained and absentees are filled from this floating crew, enabling the group to make their normal schedule. The other people in the group are guaranteed that their earnings will not be reduced below normal when new people are used to replace absentees. Quite frequently this point arises in union contract negotiations.

Question: Are group incentive payment plans easier to operate with men than with women?

Answer: One plant having a ratio of one man to four women reported that they did not get the same cooperation from women in the groups as they did with men. No other plant mentioned this condition.

Question: What is done when an operator makes his standard production before the end of the shift?

Answer: In plants using the incentive plan the operators usually level off at a certain rate of production so that their take-home pay is fairly constant. If they work too fast they sacrifice quality in order to get production, which is not desirable from the company standpoint. Early quitting has not been a serious problem in plants using the incentive plan.

In non-incentive plants the supervision insists on a fair day's work. The operator must stay at his work place and continue his job for the entire shift, even if he has made his standard production for the day sometime prior to the close of the shift. He may clean up his work area or do other work until quitting time but he must do a fair day's work for a fair day's pay. Early quitting has not been a serious problem in the plants using the flat-rate method of pay.

Members of the Panel on Progressive Assembly Techniques and Methods Are . . .

W. L. McCarthy, Leader
Factory Manager—Automotive Production
Delco-Remy Division, GMC

H. C. Riggs, Secretary
Starting Motor Plant Superintendent
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L. E. Drum
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D. Dowling
Superintendent, Assembly
Cummins Engine Co.

W. B. Terbeek
Works Manager
White Motor Co.

George Bluth
General Chief, Inspection
Willys-Overland Motors, Inc.

Question: On assembly lines using the group incentive system, when a breakdown occurs are the people required to make up this production loss?

Answer: No. They are given a down-time allowance.

Question: Is it desirable to have a progressive assembly line on a piece-work or group incentive basis?

Answer: This system is working very well in plants where the variety of work on the assembly line is not too great. Where this variety is great, it has been necessary in some plants to change from a piece-work basis to a flat rate basis because of difficulties in making the incentive system work properly. One plant, which has two assembly lines, reported that one of them was on an incentive basis while the other was on a flat-rate basis.

Question: Are all assembly jobs paid the same base rate?

Answer: In general this is true. In some plants

metal finishing or other jobs on the line do pay a higher base rate.

Question: Are piece workers hesitant to change to a new method, with a resulting change in the rate of production?

Answer: Where tooling changes or better methods have been shown to the operators, there has been little resistance on the part of the operator, even though the rate of production required is higher. It is necessary to sell the operator that he can produce a greater quantity of pieces with the new method but that no increase in effort is required because of improvements in the previous method.

General Problems

Question: Is the same effort being made to make assembly operations automatic as is being made in machining operations?

Answer: Much effort is being spent in this direction, but assembly operations vary to a much greater extent and sometimes do not lend themselves to automatic equipment as readily as machining operations. Much work is being done on transfer type of equipment to eliminate unnecessary handling of assemblies.

Question: To what extent do production supervision and product engineers cooperate in the making of final designs on new models?

Answer: Apparently this cooperation is greater in some plants than it is in others. One plant reported that a series of regular meetings is held between the production supervision, tooling department, and engineering department when a new model is to be built in order to get the best and most economical design. This mutual cooperation must be developed over several years of operation. Changes that are requested by the shop are thoroughly checked by the engineer through test samples to be sure that quality is maintained. Design committees are used extensively in various plants in order to standardize and to eliminate costly operations while maintaining the basic design needed in the product. One plant assigns their product engineers to spend 10% of their time on the assembly line in order to familiarize themselves with shop problems. Another plant brings in foremen and workmen to discuss new designs with the engineers in order that all opinions may be considered.

Question: In operating an assembly line is it better to shut the line down for operator relief or to provide replacement operators for relief purposes?

Answer: Practices in various plants vary greatly on this point. In some plants the lines are shut down for a given period at regular intervals. In other plants replacement operators for relief purposes are provided.

Question: In considering new supervision, would you hire a man from the outside with a variety of experience or would you consider people from within the plant?

Answer: One plant reported that nearly all foremen are developed and promoted from within. In other plants there is considerable hiring from the outside, especially when quick growth is necessary. In either case the personal characteristics and qualifications of the man must be given serious consideration before the assignment is made.

Question: How much difficulty is being experienced in keeping people satisfied on the same job continuously over a period of time?

Answer: This has not been a serious problem in most plants. Each plant has its methods of promotions and changes to move people from one job to another. When employees see their fellow workmen receiving promotions and new job assignments they are more satisfied because they see possibilities of future job betterment for themselves.

Question: What can be done to reduce absenteeism among women?

Answer: Some plants determine an average absenteeism rate and carry extra people for replacements from day to day. A better method of reporting illness and a thorough discussion of poor performance with the operator in many cases has shown good results. In most plants during the present period of high employment, the insurance claims of women operators have gone up. In some plants the practice of having the foremen call on sick people and maintain a closer personal contact with them has been effective. Many plants are using an investigator to go to the homes of people who are chronic absentees to determine the validity of the reasons they give for being absent from work. This problem has been a difficult one in most plants.

(The report on which this article is based is available in full in multilithographed form, together with reports of the seven other panel sessions of the 1953 SAE National Production Forum. This publication is available as SP-301 from the SAE Special Publications Department. Price: $1.50 to members, $3 to nonmembers.)

Picking the Right System For Your Truck

Albert D. Gilchrist
Assistant Vice-President, Leece-Neville Co.

Based on paper "Why Alternator Systems?" presented at SAE International West Coast Meeting, Vancouver, Aug. 18, 1953.

MOUNTING electrical loads on today's motor vehicles are causing designers to weigh the desirability of using rectified a-c electrical systems. Alternator systems are garnering more attention for two reasons. They're lighter than d-c generating systems . . . and they can deliver adequate current when an engine is idling. Only trouble is they cost about 50% more than d-c systems, but this initial cost difference is expected to decrease as production rates increase.

This being the case, vehicle designers more and more are making studies to determine whether to use a rectified a-c or a d-c electrical system. Ways they shouldn't—and should—go about deciding which to use are described below.

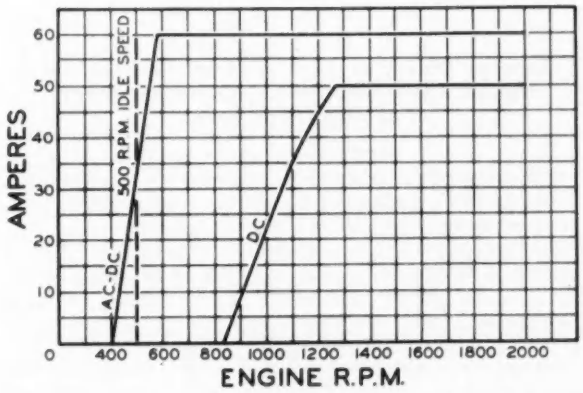


Fig. 1—Assuming a truck engine has an idling speed of 500 rpm, a 14-v, 60-amp, rectified a-c electrical system will deliver 30 amp to the load at idling speed. A 14-v, 50-amp, d-c generating system, however, will deliver nothing at this idling speed

One method not recommended is the old rule of thumb design procedure. Here, constant voltage is assumed and electrical load amperes are compared against generator rating. According to this method, the continuous load amperes should never exceed 75% of the generating rating if the system is to be reliable. Unfortunately, many electrical systems designed on this basis do not keep the battery fully charged under severe operating conditions.

Studies of these failures revealed that time should be included in the calculations. It was found that when ampere-hour loading was compared against ampere-hours generated, and a surplus was available in the generating system, we no longer had discharged batteries. This, then, appeared to be a good way to select an electrical system.

To get valid results with this technique, system calculations should be based on the poorest operating conditions. Ampere-hour load for all accessories should be computed, summed up, then compared against the total ampere-hours generated. For satisfactory operation, the load ampere-hours may be equal to or less than 80% of the ampere-hours generated, but not more!

Now, using these principles, let's consider the case of a truck operated for 10 hours under its heaviest load condition in intercity . . . and city-traffic service. It will be interesting to compare

Table 1—Continuous Electrical Load Requirements for Truck Operated in Intercity and City-Traffic Service

LOADS	PER CENT OPERATION	HOURS OPERATION	AMPERES	AMPERE HOURS
IGNITION	100.	10.	4.	40.
HEAD LIGHTS	60.	6.	6.	36.
MARKER LIGHTS	60.	6.	5.	30.
HEATER	100.	10.	5.	50.
DEFROSTER	100.	10.	5.	50.
RADIO	100.	10.	10.	100.
TOTAL CONTINUOUS AMPERES			35.	
TOTAL CONTINUOUS AMPERE HOURS				306.

Table 2—Intermittent Electrical Load Requirements for Truck Operated in Intercity and City-Traffic Service

LOADS	PER CENT OPERATION	HOURS OPERATION	AMPERES	AMPERE HOURS
STOP LIGHT	10.	1.0	2.5	2.5
TURN SIGNAL	5.	0.5	2.5	1.2
FOG LIGHTS	15.	1.5	4.0	6.0
SPOT LIGHT	2.	0.2	3.0	0.6
TOTAL INTERMITTENT AMPERE HOURS				10.3
TOTAL CONTINUOUS AMPERE HOURS				306.0
TOTAL LOAD AMPERE HOURS				316.3

the performance in such a truck of a 14-v, 50-amp, d-c generating system and a 14-v, 60-amp, rectified a-c electrical system.

Let's assume that 20% of the truck operating time in intercity service will be at engine idle, and 60% in city-traffic service. Already an advantage of the rectified a-c system becomes apparent. At the assumed truck engine idling speed of 500 rpm, the alternator will deliver 30 amp to the load while the d-c generating system will deliver nothing. (See Fig. 1.)

Keeping this fact in mind, let's chart the estimated continuous and intermittent electrical load requirements of the truck . . . and the ampere-hours of capacity available to meet it with both systems in both types of service.

Table 1 shows the estimated continuous loads, Table 2 the intermittent loads. It is always difficult to estimate the percent of operational time for intermittent loads. But since the total load of intermittent duty devices is so small compared to the continuous load, considerable error may be introduced at this point without seriously affecting the results of the evaluation.

Table 3 gives the ampere-hours of capacity available in both types of service with the d-c generating system. Note that the d-c generator operating in the country on a 10-hr cycle would develop 400 ampere-hours. Of this figure, 320 ampere-hours (80% of 400) would be the maximum available for satisfactory operation of the system. This is more than the 316 ampere-hour load requirement. City operation, with its high percentage of idle time, however, reduces the total ampere-hours generated to 200, thus permitting only a 160 ampere-hour load without discharging the battery.

Table 4 shows similar calculations for the rectified a-c system. Note that the intercity maximum load ampere-hours total 430, while the city maximum load ampere-hours amount to 335. Both these figures are well above the 316 ampere-hour load requirement of the vehicle.

Using this ampere-hour system of load analysis, then, it is possible to determine when and why to use alternator systems.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Table 3—Output of 14-V, 50-Amp, D-C Generating System on Truck Operated in Intercity and City-Traffic Service

OPERATING SPEEDS	% OPERATION	HOURS OPERATION	AMPERES	AMPERE HOURS
INTERCITY CYCLE				
IDLE	20	2	0	0
FULL LOAD	80	8	50	400
TOTAL AMPERE HOURS GENERATED				400
MAXIMUM LOAD AMPERE HOURS				320
CITY CYCLE				
IDLE	60	6	0	0
FULL LOAD	40	4	50	200
TOTAL AMPERE HOURS GENERATED				200
MAXIMUM LOAD AMPERE HOURS				160

Table 4—Output of 14-V, 60-Amp, Rectified A-C Electrical System on Truck Operated in Intercity and City-Traffic Service

OPERATING SPEEDS	% OPERATION	HOURS OPERATION	AMPERES	AMPERE HOURS
INTERCITY CYCLE				
IDLE	20	2	30	60
FULL LOAD	80	8	60	480
TOTAL AMPERE HOURS GENERATED				540
MAXIMUM LOAD AMPERE HOURS				430
CITY CYCLE				
IDLE	60	6	30	180
FULL LOAD	40	4	60	240
TOTAL AMPERE HOURS GENERATED				420
MAXIMUM LOAD AMPERE HOURS				335

To keep scheduling in the shop right side up, production control should . . .

Look to the Customer

R. S. Wetzel, Bendix-Westinghouse Automotive Air Brake Co.

Report on Panel on Production Control held at the SAE National Production Meeting, Cleveland, March 25, 1953, under the auspices of the SAE Production Activity. Panel leader was D. S. Kimball Jr., of Bendix-Westinghouse Automotive Air Brake Co.

THE key to production control in a supplier's plant is close contact between the supplier and his customers. The payoff is rapid translation of customer needs into shop schedules.

This close personal relationship between vendor and buyer helps a lot in forecasting. Of course, this kind of information has to be supplemented with historical data showing usage. Particular attention has to be given to seasonal trends, overall business conditions, and business forecasts.

Average length of commitments placed by most manufacturers is six months for finished parts, and from nine to twelve months for raw materials. Aircraft parts carry a much longer commitment and procurement time.

Sometimes commitments are made and inventory carried in advance of customer releases. Of course this varies with the type of industry. But all manufacturers generally are willing to stock materials for steady or repeating customers where engineering revisions or obsolescence are not factors.

Injecting customer schedule changes into shop and purchase schedules often is a monthly operation where schedules of a minor nature change. Schedule changes should be analyzed for amounts of materials involved to determine if a trend is developing. If the amount of material involved is considerable and if a definite trend is established, the changes should be made immediately in line with the trend noted.

Temporary work shortages stemming from customer changes may work a hardship in the shop. In some cases, this problem has been overcome by a shifting of employees. Where this isn't possible,

temporary layoffs may be the only alternative.

In general, customers don't look with favor on receiving materials ahead of schedule. Here is the way that is sometimes handled: The supplier is warned the first time (unless it was a flagrant disregard of instructions) and deferred billing is requested. The second time it happens, the material is returned.

Although the close customer-supplier relationship is important, the supplier can't expect that the customer will assume any of his (the supplier's) legal or financial responsibilities. Each business should be a separate unit responsible for its own financial and business obligations.

Once production control has accumulated its data on customer needs, it has to keep shop operations geared to these requirements.

For example, it has to decide how big the inventory should be. Entering into this determination are size and type of product, and length of time to manufacture or procure materials. Sufficient material must be maintained to assure operation of all production lines; ample inventory must be maintained to assure satisfactory customer deliveries. These factors combined determine the size of inventory necessary to conduct normal business operations. Turnover ratios vary by types of industry and types of inventory, such as service inventories versus production inventories.

In general, large assembly plants have enough stock on hand to keep from one to two weeks ahead of the assembly line. Individual parts schedules are coordinated with end-product assembly by shop orders and purchase orders. These orders carry the completion or delivery date that is in line with the required building dates of the finished parts.

The Answer Men

Members of the Production Control panel who answered questions that produced the information in this article were:

D. S. Kimball Jr., Panel Leader
Bendix-Westinghouse Automotive Air Brake Co.

R. S. Wetzel, Secretary
Bendix-Westinghouse Automotive Air Brake Co.

Eric Thompsett,
Eaton Mfg. Co.

J. E. Adams,
White Motor Co.

R. C. Stupp,
Oliver Corp.

Charles Ogan,
Thompson Products, Inc.

J. C. Mehring,
Cleveland Graphite Bronze Co.

Production control also has to anticipate parts shortages, do something about them before anything serious happens. Line shortage lists are developed in two ways: (1) by physical check of bin stocks or (2) pre-mortgage on perpetual inventory records.

Controlling peak loads as a result of quarterly material requirement breakdowns is a problem in small companies, where the economic run is a factor. Close analysis of shop requirements or shop schedules is necessary to determine starting time of individual parts. Many times the load merely is a fictitious paper load and can be reduced considerably with proper individual parts analysis.

In the record keeping area of production control, machine load records are an important responsibility. Varying results have been reported with visual type machine load records. The visual type record has proved successful for equipment of the automatic screw machine type and for starting operations.

With mechanical means of machine loading and scheduling, are dispatchers necessary, people often ask. The answer to this one is yes. Because of unanticipated events such as schedule changes and breakdowns, no way yet has been found to eliminate dispatchers.

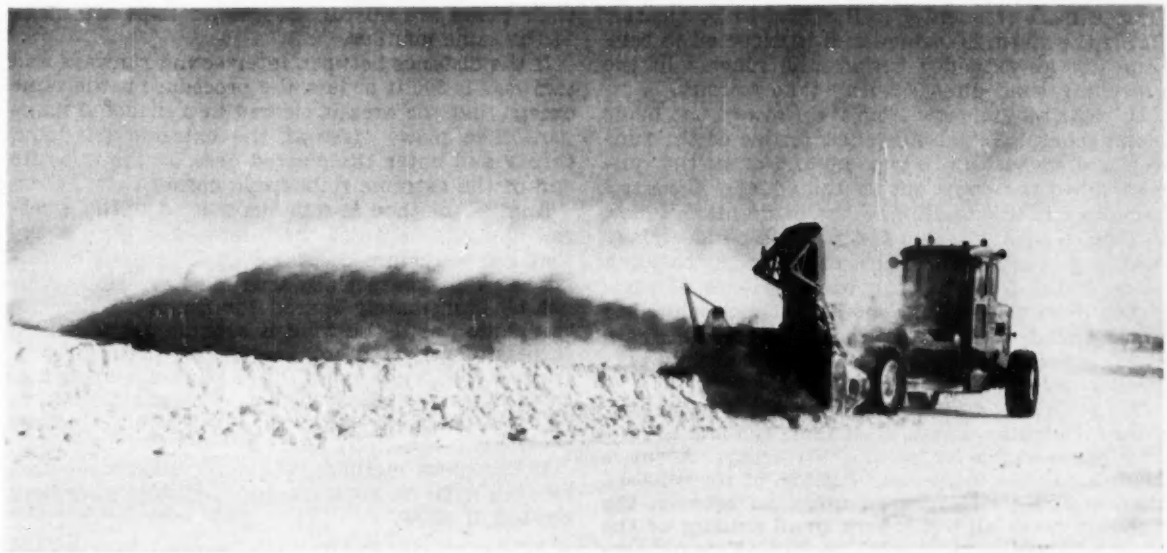
This brings up a second question. Should shop dispatchers be placed under the production foreman or should they report directly to production control? Both ways have been used successfully. However, it is suggested that the benefits derived from the dispatcher reporting to production control should not be overlooked. Such benefits include a familiarity with records, a better knowledge of overall scheduling and planning requirements, and the removal of details from the production foreman. This frees him for the supervisory functions demanded of him.

A similar who's-in-charge situation often comes up with regard to follow-up of purchased parts. The argument here is whether this is done more successfully under purchasing or production control. Here too both methods have worked well.

Some feel that the purchasing department should be responsible for delivery as well as quantity and price. Delivery should get important consideration in placing purchase orders. The buyer's responsibility for the delivery date compels more careful screening of supply sources.

It is recognized that in all supplier-customer relationships, it is necessary to give delivery promises based on the best information available, with the assurance that those promises would be kept. If it is necessary to revise promises, the customer should be notified in advance of any promise changes. In this respect the responsibility of customer to supplier is great. It should be recognized as one of the most significant phases of the customer-supplier relationship.

(The report on which this article is based is available in full in multilithographed form, together with reports of the seven other panel sessions of the 1953 SAE National Production Meeting and Forum. This publication is available as SP-301 from the SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.)



BLOWING SNOW into winds up to 30 mph is just one phase of . . .

Digging Out Airports

L. A. Johnson,

Assistant Airport Director, Minneapolis-St. Paul International Airport

Based on paper "Snow Removal and Ice Control" presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1953.

SNOW removal and ice control are of utmost concern to both the operator and users of an airport. Runways and taxiways must be kept in a safe and usable condition. How much of a job this will be depends of course on the geographical location and density of traffic at a particular airport. Therefore, while length of time and amount of equipment required to do the job will vary, the methods and type of machines used to perform the operation need not.

Machines

Blade plows and rotary plows are used for removing snow from runways and taxiways.

The operation usually calls for some standard one-way blade plows and some high-speed reversible-blade units, especially designed for airport snow-removal work at speeds of 30 to 40 mph.

In addition to these blade plows, a number of rotary plows will be needed for clean-up work and for moving snow accumulations beyond the capabilities of the blade plow equipment. Several features of the 225-hp diesel-powered auger-type rotary plow make it particularly suitable for airport use. These include its ability: to blow snow of any texture or density directly against winds up to 30 mph without any blow-back; to negotiate short radius turns; to shift from runway clearing to snow-loading operations without any loss of time.

Ice-control equipment generally includes tailgate type, self-feeding, hydraulically operated sand spreaders . . . and 3-burner, trailer-type portable weed burner or flame thrower units.

Methods—Snow Removal

In removing snow from runways and taxiways, it is important that the work start early so that the blade plows can maintain their most efficient operating speed (30 to 40 mph).

Before starting work, a decision must be made as to which runway shall be cleared first. (Traffic and weather conditions, prevailing and anticipated, are determining factors in making this decision.) The runway on which the instrument facilities are

located most frequently is the first to be cleared. But if the storm is severe—and is expected to continue for an extended period—the runway in the prevailing wind direction may take priority.

In clearing the snow from the runway, the blade plows generally start on the centerline of the runway and, by successive trips up and down the runway, move the snow out to the edges. A control car lays out the course and the blade plows follow in echelon fashion. The fast reversible-blade plows lead the way, followed by the smaller one-way blade units. Normally this operation can be completed in 30 to 40 min. But if too much snow has accumulated, or if blizzard conditions, freezing rain or excessive traffic prevail, the operation may take 45 to 60 min.

While the blade plows are clearing the runway proper, the rotary plows work along the line of runway lights at the edges of the runway. A cut is made along the inside, and outside, of these lights, then a zigzag trip in each direction between the lights removes all but a very small amount of the snow around the fixtures themselves. This remaining snow is later cleared away by small sidewalk rotary plows. Finally, as soon as the blade plows have moved the snow to the edges of the runway, the rotary plows disperse it into the grass areas well clear of the runway.

If the snow has accumulated to a depth of more than 4 in. on the runway, perhaps all of it cannot be efficiently moved from the runway to the edges in one operation. Under such conditions, it may be advisable to move the snow from the outer portions of the runway first, leaving the center portion undisturbed so that aircraft operations can continue. After this has been accomplished, the rotary plows can dissipate these windrows . . . and the blade plows move the balance of the snow to the edges.

When cross winds in excess of 35 mph prevail, one-way removal of the snow to the downwind side of the runway becomes necessary. That's because hazardous windrows should not be left on the sides of the runway when removal operations are suspended for the day. Naturally, this is a much slower and more costly operation, one which necessitates using only reversible-blade high-speed plows.

After the blade plows have cleared the first runway, they then move on either to the taxiways serving this runway or to the next most important runway. If this runway crosses or intersects the cleared runway, the runway to be cleared is done in two parts so that no snow will be carried onto the cleared area.

If winds permit moving the snow to both sides of the runway, the plows follow this procedure: They start at the left-hand corner of the intersection and proceed to a point on the centerline of the runway about 300 ft from the intersection. They then proceed up the runway to the end in the same manner as described for clearing the first runway. On the return trip, however, as the plows approach the cleared runway they make their regular cut until they reach the point where their original cut begins to angle off toward the edge of the runway. From this point on they start tapering their cut, so that when they enter the cleared runway by way of the path cleared on the initial trip their plows are raised. Successive trips are made in the same manner.

If the distance between intersecting runways and taxiways is 300 ft or less, the procedure is the same except that the area is cleared in a diagonal manner. The plows start at the extreme left-hand corner and enter the cleared area at the opposite end of the extreme right-hand corner.

Another method is sometimes used if the windrow along the edge of the intersection is so heavy that the procedure described above cannot be followed. This is especially true if rotary plows cannot be immediately spared for removing this accumulation or if the wind is such as not to permit successful use of a rotary. Under these circumstances, the snow is moved far enough back into the uncleared runway so that in clearing this area no snow will be carried by the plows into the cleared runway.

Using these methods, the work progresses area by area until all runways and taxiways have been cleared of snow.

Methods—Ice Control

Ice control, a matter of great concern to all users of an airport, is a far more difficult thing to accomplish.

To date, the only practical method is to apply sand or other suitable abrasives to the icy surfaces. (The use of chemicals commonly used for melting ice is prohibited because of their corrosive effect on aircraft metals.)

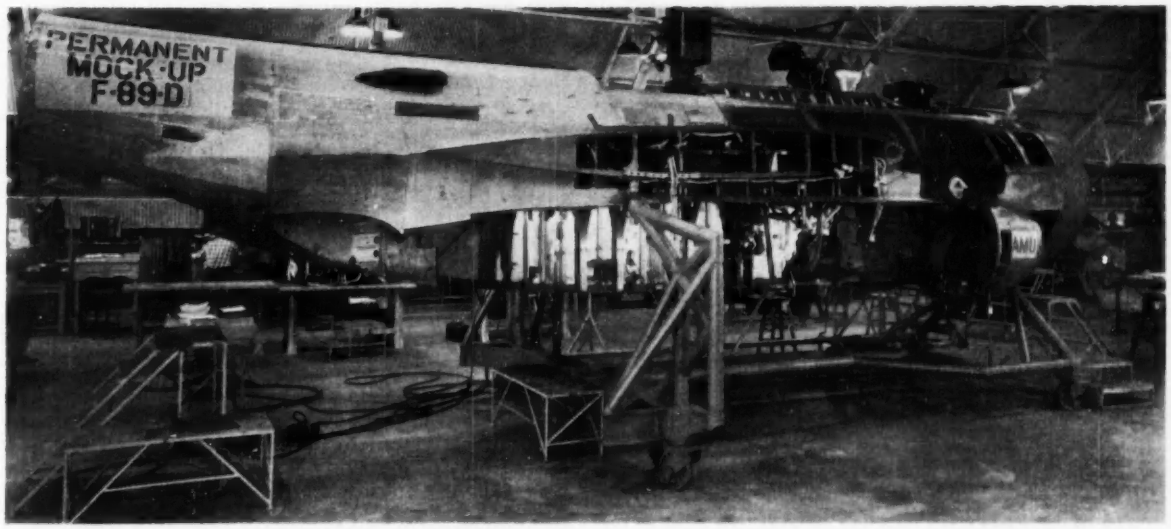
It is important, however, that these granular materials be imbedded into the ice—otherwise they will be blown off by aircraft propellors. One universally accepted method for accomplishing this is to burn the abrasive into the ice with a weed burner.

The burner unit follows immediately behind a mechanical sand spreader, heating the sand in place and impregnating the granules into the ice. The ice is sufficiently heated so that a thin film of water is created which, upon refreezing, holds the sand in place. This excellent sandpaper-like braking surface lasts until surface evaporating or thawing loosens the granules or causes them to settle below the surface.

One advantage of this method of ice control is that the burning operation honeycombs and weakens the ice structure, thus hastening its eventual dissipation. Actually, however, this ice control method is by no means considered to be an unbeatable solution to the problem. Instead, it is thought of as being only a temporary means of control, to suffice until some method is devised for applying heat to runway surfaces.

Some experimental work has, in fact, been done in an attempt to find other—and better—methods for removal of ice, but wthout much success so far. For example, an experimental ice-chipping machine has been found to work quite well when the ice is ½ in. or more in thickness. As for attempts to melt the ice, weed burners have proved satisfactory only when the ice film was very thin.

(Paper on which this abridgment is based is available in full in mulitlithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



Northrop's permanent mock-up using an actual airframe has helped check design changes before they are made on production airplanes. That's one way in which . . .

Production Plane Changes Can Be Made Less Painful

S. J. Worth, Chief Administrator, Engineering, Northrop Aircraft, Inc.

Based on secretary's report of Panel on Change Control held as part of the SAE Aircraft Production Forum, Los Angeles, October 1, 1952.

CHANGE Control doesn't stop changes. Its function is to provide a plan and schedule for incorporating the change into production items so that it least affects production schedules and costs. However, there's plenty of room for improvement on the number of changes made to an airplane model.

It has been said that both contractor and customer have been equally guilty of contributing to the increased costs of today's airplanes by insisting that new items of a development nature be incorporated into production before they have been proved. Or it may come from pressure for effectivities earlier than compatible with normal flow times within the factory.

In many cases, the contractor brings this upon himself due to the keen competition within the industry. It's only natural for him to want to be ahead of his competitors. In fact, he considers it essential to stay in business. So he will propose changes of a technological nature with an early effectivity. The result: rapid reduction of normal flow time until all work is expedited through the factory.

The customer, on the other hand, is in the position of always trying to get that "something extra" out of his airplane to meet new operational requirements. Or a parts manufacturer has impressed upon him the value of a new gadget which, in many cases, is still in engineering development.

You can't get away from the fact that when a change is expedited, the cost increases alarmingly as the expedited activity flows through the manufacturing phases. The closer the airplane is to completion when the change is made, the greater the cost. One study shows that if all manufacturing phases are expedited, the cost is quadrupled. This study shows only a part of the cost since it

Where These Ideas Came From

The ideas in this article were produced by the members of the Change Control Panel and the members of the audience they stimulated. The Panel members were:

- **H. E. Herdrich**, Panel Leader
  Northrop Aircraft, Inc.
- **N. H. Shappell**, Panel Co-Leader
  Douglas Aircraft Co., Inc.
- **S. J. Worth**, Secretary
  Northrop Aircraft, Inc.
- **Ed Hollister**
  Lockheed Aircraft Corp.
- **A. P. Schunck**
  Douglas Aircraft Co., Inc.
- **H. F. Berry**
  North American Aviation, Inc.
- **D. N. McIsaac**
  University of Southern California

includes only direct labor hours. To this must be added expedited engineering, tooling, material procurement, and premium routing, as well as the added burden cost incidental to expediting and the overtime premium that expediting implies.

Maj.-Gen. C. S. Irvine, of the Air Materiel Command, has said that although the customer and contractor are guilty to some degree for changes, most changes—particularly those of an expedited nature—are produced by the potential enemy. Each type airplane must be capable of carrying out its assigned mission. Therefore, at times, it is necessary to spend money to keep ahead of the enemy.

Gen. Irvine agreed that often lack of Air Force decision in time is responsible for shortening flow time and increasing airplane costs. To alleviate this, steps are being taken to have a representative of the Command using the airplane either resident, or in attendance at frequent meetings in the project office at Wright-Patterson Air Force Base. This helps the project engineer determine the need for the change and helps expedite contractual coverage to the contractor.

Since changes can't be eliminated from modern aircraft manufacture, the contractor has to assimilate the changes with as little disruption and added cost as possible. That's where Change Control comes in.

The plan, as provided by Change Control, covers detailed departmental schedules, number of parts to be made by preliminary methods prior to availability of the production tools, effectivity, location of the airplanes to be worked at the contractor's facility, and a schedule for kits for retroactive installation by the customer on delivered aircraft.

Changes can be broken down into four groups. The classifications closely follow the pattern established by the Air Force for classification of changes for a Mock-up Board or 689 Inspection Board Conference.

1. SAFETY of the crew, passengers, or airplane. This classification grounds all airplanes until a satisfactory solution is found to the problem. Change Control has no say in the effectivity of this particular type of change and, therefore, can only schedule the work to be accomplished.

2. MANDATORY. This classification covers those changes which are not of a safety nature, but effect the performance or operational characteristics of the airplanes and must be accomplished prior to further deliveries. These are received either as the result of a management decision or from the customer. Again, Change Control has little choice in the effectivity and merely proportions time among the various divisions and departments affected.

3. NEGOTIATED. This covers all the E.C.P. (Engineering Change Proposal) or M.C.R. (Master Change Request) types of change, which is one that changes the model specification for the product and thereby affects the contract, since the contract is formulated around the model specification. Change Control sets the effectivity after the effect on production schedules and costs has been determined and due consideration has been given to the urgency of the change. These effectivities are always subject to approval of the customer. They very often result in a difference of opinion, since the customer is always eager to incorporate changes at as early a date as possible without too much regard for the manufacturer's problems.

4. ROUTINE. Into this category fall those changes which are incorporated with normal flow time for material (such as raw stock), Production Engineering, fabricated parts, subassemblies, and installation. Examples of this type are: normal producibility changes, production planning requests, and design improvements of a "better mouse-trap" variety.

If it has been determined, after establishing a routine change effectivity, that pre-change parts were made beyond the effective point of incorporation of the change, the effectivity can be set back by Materials Review action. However, when this is done, the engineering paper and airplane records must carry the new effectivity.

Change Control has complete control over this change classification and sets the effectivity where the production effect will be negligible.

Categorizing changes is essential and in all cases the engineering paper must go through the hands of Change Control prior to release to the Manufacturing and Purchasing Division for the establishment of the effectivity.

Some disagreement exists as to whether the classification of the change should appear on the Engineering paper. However, some feel that the Engineering Project Office should be forced to sign for items where Engineering is in error. In that way it shares in the responsibility for increased

costs and possible schedule delay since it is just as much a part of the delivered article as any other Division of the company.

The question comes up as to the method employed for identifying parts, such as hydraulic cylinders or valves, where an internal change to the item had been made. This is accomplished by the use of a new part number, a letter change to the existing part number, or by color coding. In such cases all Manufacturing paper should reflect the change and show the serial number of the airplanes that will incorporate the reworked parts, and the change become part of the airplane records whether or not interchangeability is affected. If this is not done, there is no way of determining the exact configuration of an airplane in the event that an airplane meets with an accident, seriously handicapping investigations into the cause.

In this respect, it is just as essential that *all* parts, new or changed, carry a positive airplane serial identification for the same reason as above, and that this also becomes part of the airplane records. Furthermore, if this is not accomplished, the stocking of spare items or assemblies in which the changed part is incorporated becomes a hopeless task. It can result in a waste of thousands of manhours by the customer out in the field.

It is obviously impractical to make every airplane a change point airplane. Therefore, production airplanes are released in blocks to the manufacturing process, varying in quantities per block according to production rate, tooling turnover time, quantities of airplanes on order, and the degree of change at any airplane model change. Therefore, to keep costs down and production running more smoothly, Change Control's effort is directed toward the incorporation of a change only at the start of block releases. However, in the event of a safety change, this is rarely the case, and additional Engineering drawing coding is required, further adding to increased costs. All change effectivity should be confined to these "block releases" if at all possible.

(The report on which this article is based is available in full in multilithographed form together with 10 other panel sessions held at the 1952 SAE Aircraft Production Forum, Los Angeles. This publication, SP-300, can be obtained from SAE Special Publications Department. Price: $2 to members, $4 to nonmembers.)

Fatigue Life . . .

. . . of an airplane depends on fatigue characteristics of its materials, stress concentration factor, and gross area stress.

Excerpts from paper by **E. H. Spaulding** Lockheed Aircraft Corp.

TODAY's aircraft are vulnerable to fatigue because the design stresses are higher than they were in the past and because they are expected to operate for a longer period of time.

The S-N curves for the newer, higher tensile aluminum alloys are no better or worse than the old ones. If one expects more from the new materials they will give more fatigue problems.

The peak stress within a conventional wing structure is an almost direct function of gross area stress and, within practical limits, is not affected by net section stress if gross stress is held constant. For this reason, the gross area stress is a good parameter for evaluating fatigue design problems.

The 1.0 g operating stress level has frequently been used as a yardstick to compare fatigue life of similar aircraft. This has no direct bearing on fatigue life and should not be used.

Quality of design is measured by the effective elastic stress concentration factor. The state of the art is not yet developed to the point where one can always design a complicated joint and be certain that the desired quality standard has been met. Fatigue testing of joints and important discontinuities appears necessary to verify design quality. Step testing to a typical loading spectrum is believed best since it eliminates many of the assumptions necessary to interpret the results from other types of tests.

Should fatigue cracking occur, the best structure is one in which the crack can progress to a considerable extent and be found in routine inspection before causing a serious reduction in static strength. Concentrating most of the tension material in heavy spar caps is poor practice because a small crack is hard to detect and can cause a serious reduction in static strength. The best structure probably is of the conventional skin-stringer type, well distributed across the lower surface and with relatively small spar caps. Blind areas should be avoided so that visual inspection can detect fatigue cracks. Integral fuel tanks are advantageous in this respect as fuel leaks may give early warning of cracking.

Varying loads which cause fatigue come from flight maneuvers, atmospheric gusts, and ground loads. Fighters receive most of their fatigue damage from flight maneuvers. Transports accumulate most of theirs from atmospheric gusts. There can be a large scatter in fatigue damage received by a group of identical aircraft while operated under different conditions. This scatter may be as large as 100 to 1. The state of the art is now well established in this respect and the engineer must be on guard against over-conservatism. It would be better to not penalize the majority of an aircraft type because a few might be subjected to abuse.

(Paper "Design for Fatigue" was presented at the SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953. It will be published in full in the 1954 SAE Transactions. It is also available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

What glass-makers, scientists, and the public think about . . .

Night-Seeing Qualities

IT'S a scientific fact that the heat-absorbing glass used in some automobile windshields transmits less light than so-called clear glass. But this doesn't seriously impair the night-seeing qualities of the material, in the opinion of a number of concerned groups.

- Glass makers, for example, point out that heat-absorbing glass affords eye protection against high intensity daytime driving and this, in turn, tends to make night vision better.
- Scientists report very little reduction in seeing distance with heat-absorbing glass under the most critical nighttime driving conditions (two cars approaching each other from a distance of 500 ft).
- Vehicle manufacturers note that heat-absorbing glass has passed the real acid test—car owners who have used it often come back for more.

Glass Makers Report

Representatives of two of the major glass manufacturers—Dr. W. J. Arner, Libbey-Owens-Ford and R. G. Whittemore, Pittsburgh Plate Glass—cleared up some of the misconceptions about heat-absorbing glass.

They refuted the much-publicized opinion that heat-absorbing glass interferes with viewing pleasure at outdoor movies. Arner and Whittemore reported they had been in touch with the Texas movie operator group which had first highlighted the issue and had found that the allegation had originated in a jesting remark which was taken seriously.

Dr. Arner pointed out that every windshield, since the first one put in use, has transmitted less light than would have been available if the vehicle were operated without a windshield. But the troubles associated with the use of goggles made the problem of loss of light transmittance through windshields small by comparison. In short, loss of light with windshields was and always has been taken for granted.

Summarizing his position he said: "We do not believe that for rested eyes in nighttime driving there will be *no* loss of visual efficiency through heat-absorbing glass, but we are sure the loss is small and about equal to the standard error of measurement. *We do believe* that shaded heat-absorbing glass affords protection against high intensity daytime driving which tends to protect night vision."

Whittemore, differentiating between heat-absorbing glass and windshields that have a tinted shade across the top, noted that some people erroneously believe that a wide variety of tinted glasses are used in automobiles. Some of the reasons he gave for this were:

1. The multiplicity of names for heat-absorbing glass, some of which emphasize color or tint and tend to ignore heat-absorbing characteristics.

2. Heat-absorbing glass viewed from outside an automobile looks different depending on whether the day is dark or bright . . . and what color the car is.

3. Heat-absorbing glass often appears darker when it is viewed from the outside. That's because the observer almost always looks through two glasses, and sometimes three, in viewing the car equipped with it.

4. Upholstery color plays a part in the *appearance* of heat-absorbing glass.

5. Variations in color may actually exist in some of the imitations marketed today.

Actually, there is not much tint in heat-absorbing glass, he emphasized.

Scientists Report

Val J. Roper, of General Electric, reported briefly on the results of night tests made at Orlando, Florida, early in 1952 on cars equipped with both heat-absorbing and clear glass windshields. He explained that the test procedure called for observer-drivers to report seeing distance as they approached each other.

Analyzing the results of 2280 test runs, it was found that the average reduction in overall seeing distance for the heat-absorbing windshields was only about 3%. Of considerable significance was the fact that when two cars were about 500 ft apart in the critical "meeting zone," there was no reduction in seeing distance with heat-absorbing glass.

In Roper's opinion, only driving tests provide a really satisfactory measure of night seeing for a motorist. It is very difficult to get good correlation between laboratory experience and experience driving a car, he said. You cannot establish space relationships in the laboratory, nor can you properly include the time factors.

# of Heat-Absorbing Glass

W. F. Sherman, Automobile Manufacturers Association

Based on secretary's report of Round Table on Heat-Absorbing Glass held under the auspices of the SAE Passenger Car Activity at the SAE Summer Meeting, June 10, 1953. Round Table Leader was Capt. W. L. Groth, Department of State Police, Va.

Dr. H. R. Blackwell, of the Vision Research Laboratory of the University of Michigan, defended the laboratory experimental technique. He maintained that, with it, one can study wider ranges of variables and find out for certain what the most critical conditions are for the study of given problems.

Blackwell reported that laboratory tests made to determine the visibility of objects contrasting with their background had led to the development of a family of curves which were generally comparable with Roper's data. Under conditions assumed to be those of the Orlando tests, comparatively small losses are predicted from the laboratory data, he said. However, it might be possible to select conditions in which the seeing distance through a heat-absorbing windshield (regarded as a neutral filter) would be reduced substantially, Blackwell pointed out. Adverse effects on seeing would be greater with reduced background brightness and lower as contrast between the target and the background decreased. Speaking of glare, he noted that the introduction of a bright light near the object to be seen would result in a reduction in target contrast. Rather than undo the damage of glare, a filter would actually make the effects of glare worse because of reduction in brightness level, Blackwell said.

Vehicle Manufacturers Report

H. C. Doane, of Buick; L. W. Parr, of Chrysler; and O. Rugg, of Ford, indicated that more than 2½ million installations of heat-absorbing glass have been made in automobiles since 1950 . . . and no complaints from vehicle owners yet. What's more, there is substantial reordering by people who have used heat-absorbing glass when it comes time to buy a new car, they reported. And as Doane put it, the public does not repeat its purchases unless it is satisfied with the value of a product—no matter how much merchandising effort is put into selling it.

Panelists who expressed these opinions on heat-absorbing glass were:

Capt. W. L. Groth, Leader
Department of State Police, Virginia

W. F. Sherman, Secretary
Automobile Manufacturers Association

W. J. Arner
Libby-Owens-Ford Glass Co.

Dr. H. R. Blackwell
University of Michigan

H. C. Doane
Buick Motor Division
General Motors Corp.

L. W. Parr
Chrysler Corp.

V. J. Roper
General Electric Co.

Ormond Rugg
Ford Motor Co.

R. G. Whittemore
Pittsburgh Plate Glass Co.

. . . The real solution to the mystery of successfully producing large aluminum forgings naturally awaits the arrival of the USAF's giant presses. In the meantime, several experts offer some important clues . . .

The Case of the Yet-to-be-Made

THERE'S no doubt about it—the forging presses the U. S. Air Force has on order will dwarf the largest presses now in operation in this country. But there's no doubt about this, too—too much emphasis has been placed on press size or capacity as such, in the belief that extremely high pressures will produce a complex forging of any size. It just isn't so. No amount of pressure will cause metal to flow if the conditions are not right. Determining what constitutes right and wrong, then, is the job which aircraft designers, forging designers and production men face today. Here are some of the things that are indicated:

- Unit forging pressures should be kept as low as possible.
- Quality of die blocks will have to be improved.
- Die deflection should be held to an absolute minimum.
- Die-closure tolerances must be reduced.
- Forging stock should be selected for its forging qualities.
- Special auxiliary equipment needed to produce these large forgings must be available.

Watch Those Forging Pressures

If these giant presses are to produce the thin-webbed, narrow-ribbed panels that aircraft designers want, then forging designers are going to have to keep forging pressures down. For while the whole secret of producing such pieces lies in proper forging and die design and in suitable production practices, the objective in all three of these cases is to reduce necessary unit pressures to the absolute minimum.

For example, if a press has a capacity of 50,000 tons and a forging requires 40 ton per sq in. to make, the machine can only produce a piece about 35 in. square. However, if by skillful design and fabricating techniques this required pressure can be reduced to 15 tons per sq in., the press can fabricate a panel about 30 by 100 in. In other words, a 50,000-ton press becomes equivalent to a 150,000 tonner; or looked at another way, it may be reduced in effectiveness to 15,000 tons.

Now what are some of the things a forging designer can do to reduce the unit pressure necessary to produce his forging?

Consider the case of thin webs, particularly in boxed-in sections, which tend to freeze between die surfaces and create enormous resistance to flow. By providing "punch-outs," a forging designer can supply a place for the excess metal to flow . . . and this not only makes a thinner web possible, but it also greatly reduces the pressure required.

Sometimes a designer cannot allow a punch-out, but can arrange the rib disposition so as to avoid completely boxed-in sections and trapped metal.

Ways are also open for the forging die designer to reduce required unit pressures. In determining the number of blocking dies and the design of the impressions in each, he should always aim to provide the minimum resistance to flow and the optimum distribution of metal for the next operation. Also, since the surface of a die has an important effect on metal flow, polished or plated dies may be warranted.

As for actual production of the piece, stock temperature, die temperature, and die lubrication can make or break the operation. One point worth remembering is that, in general, the hotter the dies, the lower will be the flow resistance. (Unfortunately, however, the hotter the dies, the greater is the problem of die lubrication . . . and the problem of maintaining certain dimensional tolerances.)

Improve Die-Block Quality

Consideration will also have to be given to the quality of die blocks. Why? Because large forgings with deep ribs will reach hitherto unreached portions of die blocks that are not as sound as those within a few inches of the surface. Thus, the improvement of die-block quality will be necessary to reduce the chances of die breakage.

Large Aircraft Forging

A. E. Favre, Aluminum Company of America
C. W. Andrews, Douglas Aircraft Co., Inc.

Based on papers "Light Alloy Forging Design and Production Problems as Related to Heavy Press Operations" by Favre, and "Design Considerations Associated with Large Aluminum Forgings" by Andrews. Cosponsored by ASME, IAS, and SAE, these papers were presented at the Semi-Annual Meeting of the American Society of Mechanical Engineers, Los Angeles, July 1, 1953. Papers may be obtained from ASME, 29 West 39th Street, New York City.

Hold Die Deflection to a Minimum

Holding die deflection to a minimum is going to be extremely important for successful operation of this new species of forging press. That's because concentration of die stresses on these 35,000- and 50,000-ton monster presses will easily be able to reach such magnitudes that no material can withstand failure. Therefore, it may be necessary to make deflection measurements under pressure to make certain that deflection remains within safe limits.

This need for being extremely meticulous about set-ups is emphasized by the fact that usually it will not be possible to provide spare or reserve dies for these large complex forgings. Cost in time and money will be too great, and spare equipment is not the answer to the problem anyway. If you can break the original, you can break spares, and in the end you will have to eliminate the cause.

Cut Die-Closure Tolerances

At the same time, care will have to be exercised to see to it that weight penalties don't result from the use of large forgings. This means that die-closure tolerances will have to be reduced. For while these larger presses will be able to produce forgings with thinner webs, this achievement will be of little value if die-closure tolerances remain at their present level.

An indication of weight penalties that result from even small tolerances can be seen from this example. Areas exceeding 2000 sq in. will probably be common with the 35,000- and 50,000-ton presses . . . and in 2000 sq in., a tolerance of 0.03 increases the weight by 6 lb!

It may be that partially machining rough forgings prior to performing the finish die operation may alleviate the die-closure problem. But it is hoped that eventually the larger presses will reduce variations in weight through closer tolerance control. In the meantime, if suitable thickness and draft cannot be produced in the die-forging blank, then they will have to be machined into the finished part. Forging designers should recognize this and provide for economical reduction of thickness by machining.

Mismatch tolerances, too, will have to be kept to a minimum. Among other things, this means that ways and means will have to be found to achieve uniform temperatures between top and bottom dies and to reduce the variation resulting from die-sinker tolerances.

Forgings having thin webs and ribs, together with small draft angles, are bound to be difficult to hold to very close straightness tolerance. Warpage is apt to occur during the forging operation and during heat-treating. It may be necessary, therefore, to resort to the use of mechanical ejectors to remove these forgings from straightening dies.

Choose Proper Material

But regardless of how well all of these considerations are handled, the success of the forging operation on one of these giant presses will hinge on the material selected and the design of the forging itself.

Forging designers should keep in mind the fact that the higher strength aluminum alloys have poorer forgeability than the lower strength ones. Thus, they will do well not to specify an alloy of relatively difficult forgeability unless they require

its higher mechanical properties for the application.

As forgings grow larger, it's also going to be necessary to refine quality-control procedures and expand sonic inspection methods. The important point to remember here is that the forging process will not change substantially the quality level inherent in the stock.

When it comes to forging design, designers will remember that increases in forging thickness mean decreases in forging strength and elongation. Thus, with the growth in forging size, it will be essential to: (1) maintain the smallest possible cross-sectional area compatible with final part requirement, (2) avoid loading in the short transverse direction, (3) account for resulting reductions in strength and elongation, (4) obtain maximum material properties by rough machining the forging prior to heat-treatment, and (5) carefully consider the grain direction for orientation with respect to loads.

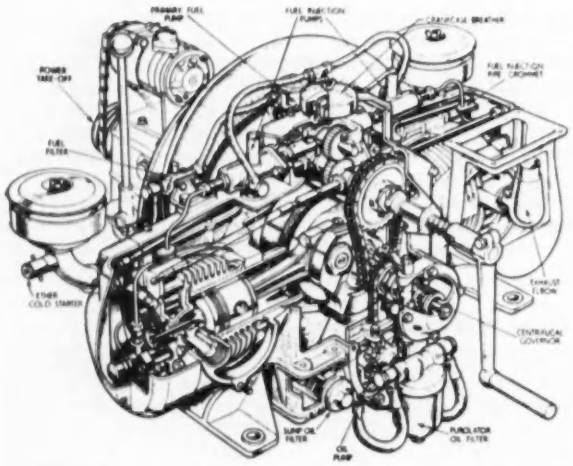
Auxiliary Equipment Must Be Available

Finally, before a designer takes the large forging route, he'll want to make sure that all the special, large auxiliary equipment necessary to produce the forging is available. For example, whether die-sinking machines are available to handle the die-sinking job . . . and whether sufficient milling capacity exists for transforming the forging to a finished part.

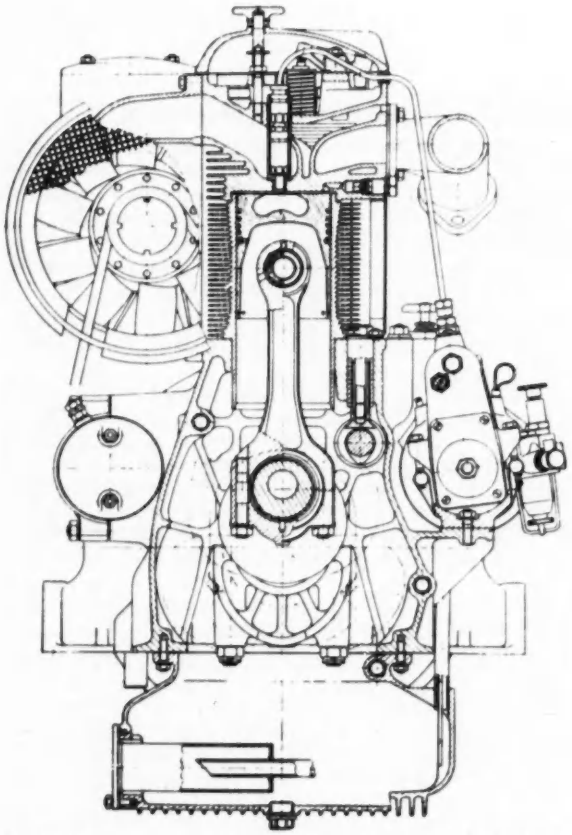
Actually, when it comes right down to it, the future trend of forging design can only be established after comprehensive experience is obtained through use of the new heavy presses. Until then, it may be well to temper our optimism with the recognition of our present knowledge of the forging art, and temper our pessisism with the confidence in our ability to solve problems as they arise.

CORRECTION

AN ERROR was made in the 1953 September SAE JOURNAL article, "Europeans Take to Aircooled Diesels." The pictures of the British Enfield and Swiss Locomotive Works diesel engines were transposed. On pages 74 and 75, the correct illustrations should be:



British Enfield twin-cyl aircooled diesel engine



Swiss Locomotive Works' 4-cycle aircooled diesel engine

SAE Section Meetings

Atlanta—Dec. 11

Ship Ahoy! Restaurant. Dinner 6:30 p.m., meeting 7:30 p.m. Engineering Frontiers—1953 SAE President Robert Cass.

Baltimore—Dec. 8

Engineering Frontiers—1953 SAE President Robert Cass.

British Columbia—Dec. 14

Hotel Georgia, Vancouver, B. C. Dinner 6:30 p.m. Meeting following. Practical Aspects of Automotive Engine Operation—J. Brent Malin, research engineer, E. I. duPont de Nemours & Co., Los Angeles.

Buffalo—Dec. 10

Hotel Sheraton. Dinner 6:30 p.m., meeting 8:00 p.m. Miracle Fabrics—Leonard H. Schick, products information section, E. I. duPont de Nemours & Co., Buffalo. Ladies night plus presentation of 25 and 35 year certificates.

Canadian—Dec. 16

Roof Garden, Royal York Hotel, Toronto. Dinner 6:30 p.m., meeting 8:00 p.m. R. H. Combs memorial night. Speaker to be announced.

Central Illinois—Dec. 14

Jefferson Hotel, Peoria, Ill. Dinner 6:30 p.m., meeting 7:45 p.m. An Analytical and Experimental Study of Low Pressure Air Ejector Pumps—H. R. Moss, research engineer, Caterpillar Tractor Co. Starting Cold Diesels—N. K. Lammers, research engineer, Caterpillar Tractor Co.

Cleveland—Dec. 14

Tudor Arms Hotel. Dinner 6:30 p.m., meeting 7:30 p.m. Symposium on Package Air Conditioning—Howard Dunn of Chrysler; H. V. Joyce of Ford; and F. W. Edwards of Eaton Mfg.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

Colorado—Dec. 17

Denver and Rio Grande Shop. Meeting 8:00 p.m. Diesel Engine Maintenance—L. C. Atchinson, chief chemist and technical adviser, Denver and Rio Grande Railroad, Denver, Colorado. This will feature a shop tour of the diesel engine shops.

Detroit—Dec. 7

Rackham Educational Memorial Building. Dinner 6:30 p.m., meeting 8:00 p.m. Will Americans Trade the Family Car for European Styling—George Romney, executive vice-president, Nash-Kelvinator Corp. Dinner speaker—Robert Smith, Detroit Lions.

Indiana—Dec. 10

Marott Hotel, Indianapolis, Ind. Dinner 7:00 p.m., meeting 8:00 p.m. More on the G. M. Model 51 Diesel Engine—Roger Wellington, assistant director of laboratory, Detroit Diesel Engine Division, GMC.

Kansas City—Dec. 15

Linwood & Paseo, American Legion Hall. Dinner 7:00 p.m., meeting 8:00 p.m. 6 Volts versus 12 Volts Electrical Systems—H. L. Hartzell, assistant chief engineer, Delco-Remy Division, GMC.

Metropolitan—Dec. 10 and 16

Dec. 10—Brass Rail Restaurant, Fifth Avenue and 43rd Street. Cocktail Hour—5:30 p.m. Dinner 6:30 p.m., meeting 7:45 p.m. Air Suspension in Commercial Vehicles—Charles O. Slemmons, chief product engineer, Central Development Department General Tire & Rubber Co.

Dec. 16—The Engineering Societies Building, 29 West 39th Street, New York, Fifth Floor. Meeting 7:45 p.m. Power Brakes for Passenger Cars—E. E. Hupp, development engineer, Bendix Products Division, Bendix Aviation Corp.

Mohawk-Hudson—Dec. 8

Panetta's Restaurant, Menands, N. Y. Dinner 6:45 p.m., meeting 8:00 p.m. New Air Applications of Brakes and Other Automotive Devices—J. V. Ralston, manager, sales engineering, Bendix-Westinghouse Corp.

Philadelphia—Dec. 9

Engineers' Club, Philadelphia, Pa. Dinner 6:30 p.m., meeting 7:45 p.m. Mobilgas Economy Run—Hugh S. Kelly, staff engineer, Socony-Vacuum Oil Co., N. Y. Technical Chairman—Josiah French.

Salt Lake City—Dec. 14

Terrace Room, Newhouse. Meeting 8:00 p.m. The Preignition Problem—W. E. Morris, supervisor, Road and Knock Test Group, E. I. duPont de Nemours & Co., Petroleum Laboratories, Carney's Point, N. J.

Southern California—Dec. 17

Rodger Young Auditorium. Dinner 6:30 p.m., meeting 8:00 p.m. The Preignition Problem—W. E. Morris, supervisor, Knock and Road Test Group, E. I. duPont de Nemours & Co.

Spokane-Intermountain—Dec. 15

Caravan Tavern. Dinner 6:30 p.m., meeting 7:30 p.m. Materials Handling—company engineer, Lamson Corp.

Texas—Dec. 11

U. S. Naval Air Station, Dallas. Dinner 7:30 p.m., meeting 8:30 p.m. Fuels and Jet Transportation—H. A. Fremont, combustion specialist, General Electric Co., Evendale, Ohio. Cocktails at 6:30 p.m. at Officers Club.

Virginia—Dec. 9

William Byrd Hotel. Dinner 6:30 p.m., meeting 7:00 p.m. Engineering Frontiers—1953 SAE President Robert Cass.

Washington—Dec. 7

Congressional Hotel. Dinner Meeting. Engineering Frontiers—1953 SAE President Robert Cass.

Wichita—Dec. 15

Droll's English Grill. Dinner 6:30 p.m., meeting 7:30 p.m. New Materials for use in the Aircraft Industry. Speaker to be announced.

Williamsport—Dec. 7

Lycoming Hotel. Dinner 6:30 p.m., meeting 7:45 p.m. Electronics in Industrial Application—Martin Maloy, field engineer, Burlingame Associates, 103 Lafayette St., New York 13, N. Y. Demonstrations of various types of electronic equipment.

Canadian and U.S. Production Harmonize on Manufacturing

INTERCHANGE of production ideas at the first SAE International Production Meeting and Forum in Toronto, October 29-30, again demonstrated that national boundaries need not be curtained in iron. The more than 600 production men and engineers who attended this hands-across-the-border meeting proved that Canada and the United States are almost as alike as peas in a pod when it comes to manufacturing techniques and problems. The differences are minor, the similarities great.

The kinship of ideas, the mutuality of engineering thinking, and the sameness of industrial objectives in Canada and the U.S. were echoed and re-echoed at Forum panels, in technical papers, during plant trips, and in dinner talks.

The cooperation and understanding between U. S. and Canadian engineers at the Meeting was proof-positive that both countries are working together, as urged by President Eisenhower during his visit to Ottawa last month.

At the dinner, SAE President Robert Cass noted, "This exchange of production ideas means more to the defense of our two countries than most people realize." He stressed common interests and skills in both countries and the ways in which they supplement each other.

Dinner speaker R. M. Brophy, Deputy Minister of Defence Production, Canada, pointed out one of the differences between the two countries. Canada is rich in natural resources, while the U.S. is depleting what it has. He said, in part, "When you talk of what the future has in store, I would ask you to look not to Canada's defense program, but to the economy as a whole. We are going through a period of expansion and prosperity that augurs well for the future.

"The discovery of oil in Alberta and iron ore in Quebec-Labrador has opened up new possibilities for further industrial expansion. Canada has many of the basic resources which are in short supply in other parts of the world.

"It is significant that the United States is rapidly becoming a deficit nation with regard to many essential materials. Our extensive supplies of many of these basic products have contributed materially to our progress in the past and will undoubtedly play an even more important part in our economic future."

Costs Plague Car Makers

Another difference between the two countries is the size of the market served by industry in each. Reconciling smaller Canadian production to larger U.S. production in the automotive field is not without its problems, one of the Forum panel sessions brought out.

Canadian affiliates produce pretty much the same vehicles as their American counterparts. So, relatively the same tooling costs have to be spread over a much more limited production. That calls for production ingenuity, with the emphasis on flexibility.

Welding operations is one example of this cited at the meeting. Instead of building a single, high-production welding fixture in which a part can be welded in various positions, one Canadian vehicle maker builds several different fixtures to do the same job. This brings down capital costs and provides flexibility.

Another step Canadians have taken to help spread capital investment over a longer period is to deviate from American design where the deviation doesn't create service problems. For example, U.S. car manufacturers will change hub cap design each year. The Canadian manufacturer will redesign hub caps every four or five years to amortize die costs over longer periods.

Canadian vehicle makers also have to live with legal and fiscal policies of the Canadian government, which specify the minimum British Empire

Men Aims

content in cars. That limits the amount of parts that can be purchased from the U.S.

Smaller production needn't keep Canadian manufacturers away from modern machinery, it was pointed out at the panel on production tooling. For example, transfer machines definitely have a place in smaller shops. It's just that they have to be handled somewhat differently. In Canada, the trend is to go to transfer machines made up of multi-purpose standardized units rather than to the highly specialized machines used south of the border. Transfer machine drilling units are standardized as to size and shape, and have spaces for additional tooling.

On the side of sameness, engineers from both countries revealed that they are trending in the same directions on production techniques and shop methods. Engineers and production men in Canada and the United States have built up much the same relationships with colleagues in their own plants and with their counterparts in other plants.

As one man at an informal luncheon said, "Pick any man attending these panel sessions. Listen to him speak, hear out his problems, analyze his thinking. Until he actually mentions his company connection, you can't tell whether he's Canadian or American."

Marrying Design and Production

In practically every session during the SAE meeting at Toronto, one thought kept cropping up again and again: Design engineers and production men have to work together closer than ever if costs are to be kept down, manufacturing efficiency increased, and product performance improved. Men from foundries, engine factories, forge shops, and airframe plants echoed the same idea.

At the foundry panel, men who make castings cried for greater coordination with design engineers. They felt many foundry problems would disappear if engineers would call in foundry specialists during the drawing stage. And engineers could give the foundry a big assist by working closely with the pattern shop in the master pattern stage.

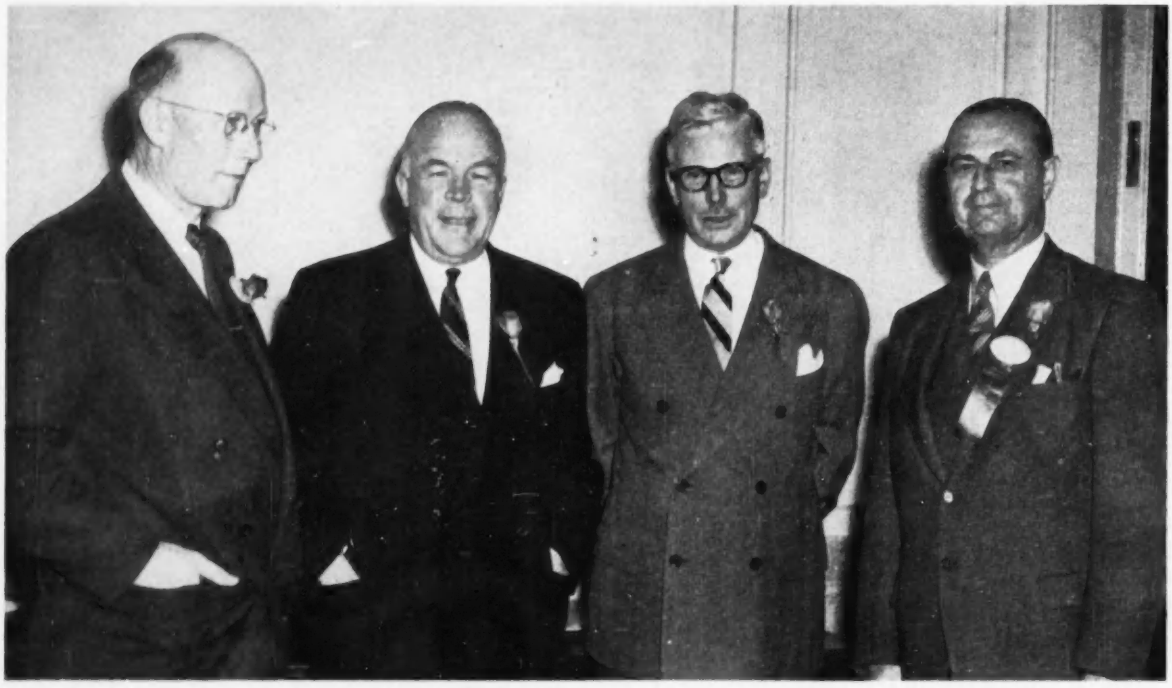
Forging men have almost the same things to say. At the forging panel session, it was shown how consultation with forgers in the early stage of design study would achieve the manufacturer's main goal—lowest cost at point of assembly. The forging engineer is equipped to advise on weight-size relationships, metallurgy, and production tooling.

Many forge shops today feel they are caught in a squeeze. The trend is toward lower and lower forging tolerances to eliminate as much machining as possible. Forgings are being designed with low draft or no draft at all. Greater design-forge shop coordination may help ease this growing problem.

Experimental Shop Is the Link

In the airframe industry, the trend is toward increased overlap between the prototype stage and production. That calls for production engineers to lend a hand in speeding prototype completion,

Dinner Headliners . . .



Featured on the dinner program were (left to right): A. A. Scarlett, chairman of the SAE Canadian Section; Dinner Speaker Reginald M. Brophy, Deputy Minister, Department of Defence Production, Canada; SAE President Robert Cass; and R. W. Richards, toastmaster and general chairman of the meeting

. . . Program Framers

The technical program for the meeting was put together under the leadership of (left to right): Col. M. P. Jolley, chairman of the Production Forum; N. P. Petersen, SAE vice-president for production; and E. D. Kemble, meetings vice-chairman of the SAE Production Activity Committee

noted R. B. McIntyre, executive engineer, of de Havilland Aircraft of Canada. He reported that the key to smooth transition between design and production in his company is the experimental department. At de Havilland, the experimental department is a common meeting ground for the design and production engineers.

A group of production engineers stationed in the experimental shop advise on all details from a production angle, such as:

1. Making suggestions to designers before experimental drawings are made. This assures best use of existing production equipment.

2. Drawing up schedules for long-delivery materials (such as forgings, castings, and extrusions) to give the production department an early lead.

3. Guiding the experimental shop to the best way of making prototype parts. In certain cases, the shop can go a long way toward making the final production tooling.

4. Observing various detail assemblies and discussing potential production difficulties with designers.

Val Cronstedt, director of engineering, A. V. Roe, Canada, observed that in his organization it's the engineering group which takes the initiative in production-design relationships.

He pointed out the unique position of the engineering organization in an aircraft engine plant. It stems from the fact that an aircraft engine is a developed mechanism rather than a designed article. Perhaps the distinction is a fine one, said Cronstedt. But it's a fact that we frankly do not know why an engine works. In one engine model a certain mechanical treatment fixes some difficulty; in another, that same treatment fails completely.

Such an apparatus is notoriously sensitive to small changes in dimensions and materials. "So once you embark on an aircraft engine manufacturing venture," said Cronstedt, "you have to tolerate a bunch of engineers milling around, continuously changing this or that."

Changes Like Death and Taxes

Nor is change restricted to aircraft engines. It's a common item in airframe production. Dean P. Stowell, assistant to the president of Canadair, observed that the only thing constant about his business is change. He reported that after building substantial quantities of one particular model, his company still is processing 750 changes per week.

Cronstedt's word picture of the organization and planning that go into creation of a modern engine plant took on added significance for some 100 men who visited the new Avro engine plant. They were treated to a guided tour of one of the most modern engine plants in the world. The plant produces the Orenda gas turbine, which powers the CF-100 jet fighter. This completely air-conditioned plant

Around the Meeting . . .

SAE President Robert Cass told of the time that Androcles, the Roman slave, was forced into an arena with a lion. The crowd of spectators expected to see Androcles torn to shreds. Instead, they saw him whisper into the lion's ear and then ride out of the arena on the lion's back. This was an unheard of miracle and the Romans asked Androcles what he said to the lion that spared his life. Replied Androcles, "I told the lion, now look here, if you eat me you'll have to make an after-dinner speech."

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The Red: Harvard is a place where people unlearn to speak English, said toastmaster R. W. "Dick" Richards.

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And the Blue: An illustrious political figure addressing the students at Yale, thought he had a new twist in his speech, said Dinner Speaker R. M. Brophy. He gave his talk extolling Yale in terms of the letters in its name saying . . .

- "Y" is for Youth,
- "A" is for Alertness,
- "L" is for Loyalty, and
- "E" is for Enthusiasm,

. . . and spent some 30 min. discussing each of these qualities that he found in the Yale student body. During his lengthy presentation, he noted one student deep in thought. He asked the young man what he was thinking about during the speech, and was told, "I was thinking how lucky I am that I wasn't a student at the Massachusetts Institute of Technology listening to your talk."

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T. N. Beaupre, assistant Deputy Minister, Department of Defence Production, Canada, chairmanned the technical session. Secretary was W. E. Corfield, of the Air Industries and Transport Association.

The Meeting Served Up . .

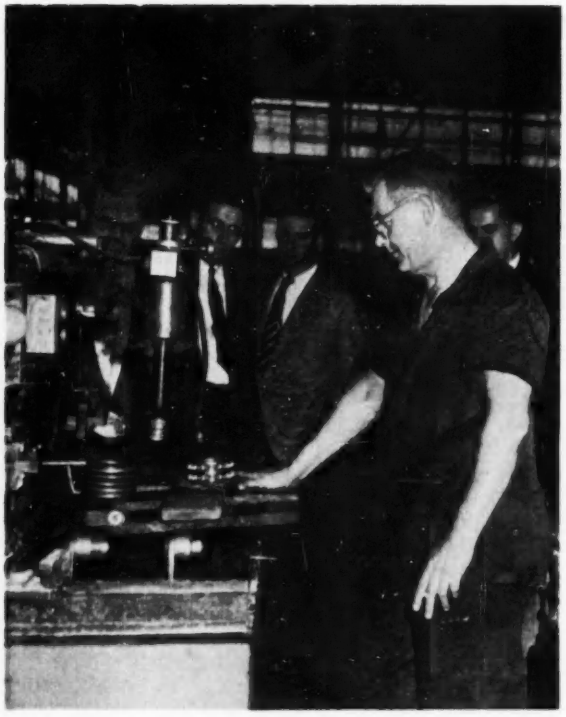
Splendor . . .

A Scottish bagpiper in full regimental regalia furnished the musical escort for the speakers' table guests

. . Glamour

SAE President Robert Cass and all guests at the pre-dinner reception were presented with a rose boutonniere

. . . and Technical Content



Trips to the Massey-Harris-Ferguson farm equipment plant and the A. V. Roe engine plant capped the two-day meeting

started operations in July of last year and is now producing the Orenda in sizable quantities.

A second group, nearly as large, visited the Massey-Harris-Ferguson plant in Toronto. They saw there manufactured farm equipment such as pull-behind and self-propelled combines, hay balers, cultivators, disc harrows, and flows.

Buyer and Supplier

Vendors and customers run into the same kinds of problems, in both Canada and the United States. Any number of cases cited at Forum panel sessions brought knowing nods from many who had similar experiences.

For example, production control men pointed out the penny-wise-pound-foolish buying methods of steel users. They pay little attention to the smallest run they can buy at the most favorable price. If the minimum run price is based on five-ton quantities, many steel users will buy four tons one month and two tons the next.

However, buyers are much sharper when it comes to quality of purchased parts. In both Canada and the United States the Vendor Certification Program is being increasingly adopted. Under such a program, the customer agrees to accept a shipment of parts if they are no more than X% defective. If the percentage of defective parts exceeds the agreed-upon figure, the vendor has to take back the entire shipment.

This discussion showed that in the long run establishment of sound quality control procedures saves a manufacturer money. The cheapest way to make any product is to make it right. All agreed that it's a lot less costly to make 100 good parts than to make 90 good parts and 10 bad ones.

It was cautioned that management shouldn't expect to see immediate cost reductions from the installation of quality control.

In the materials and heat-treat panel session, metallurgists swapped ideas for improving life of metal parts. One of the things they discussed was the use of compressive stress patterns in truck rear axles to better service life.

This is being done in one of two ways: (1) water quenching to get a hard case and soft core, or (2) induction hardening of lower carbon content material. The trend is toward the induction hardening method since it reduces straightening.

Qualities of people as well as of materials received important consideration at the meeting. In the session on selection and training of technical and supervisory personnel, it was said that promotion and selection criteria are taking on a new look. Managements now are giving more emphasis to a person's ability to get along with people than in the past. Until recently, technical qualities required for a given job were the sole basis for hiring or promotion.

Learning about Learning

Management, particularly in the airframe business, has learned much in recent years as to what to expect from shop personnel in the way of productivity. Stowell recalled the learning curve concept, developed by T. P. Wright, which established the way in which direct manhours are reduced with increasing quantities of production. It was during World War II that the aircraft industry came around to accepting this idea.

In essence, the concept says that a constant percent increase in cumulative plane number is accompanied by a constant percent decrease in unit hours. Wright's 80% learning curve implies that doubling the cumulative plane number cuts unit manhour expenditure to 80%.

For example, if it took 10,000 direct manhours to build the 100th airplane, the 200th airplane would require only 8,000 direct manhours.

Section Spark Plugs

Among the Canadian Section members who contributed to the success of the SAE International Production Meeting are L. E. Nourse (left) and C. E. Phillips (right), co-chairmen of the Reception Committee, and George R. Jackson, chairman of the Publicity Committee

Production Specialists Who Were

on Question-and-Answer Panels

Transportation Speakers Indicate . . .

Designs Must Be Compromised

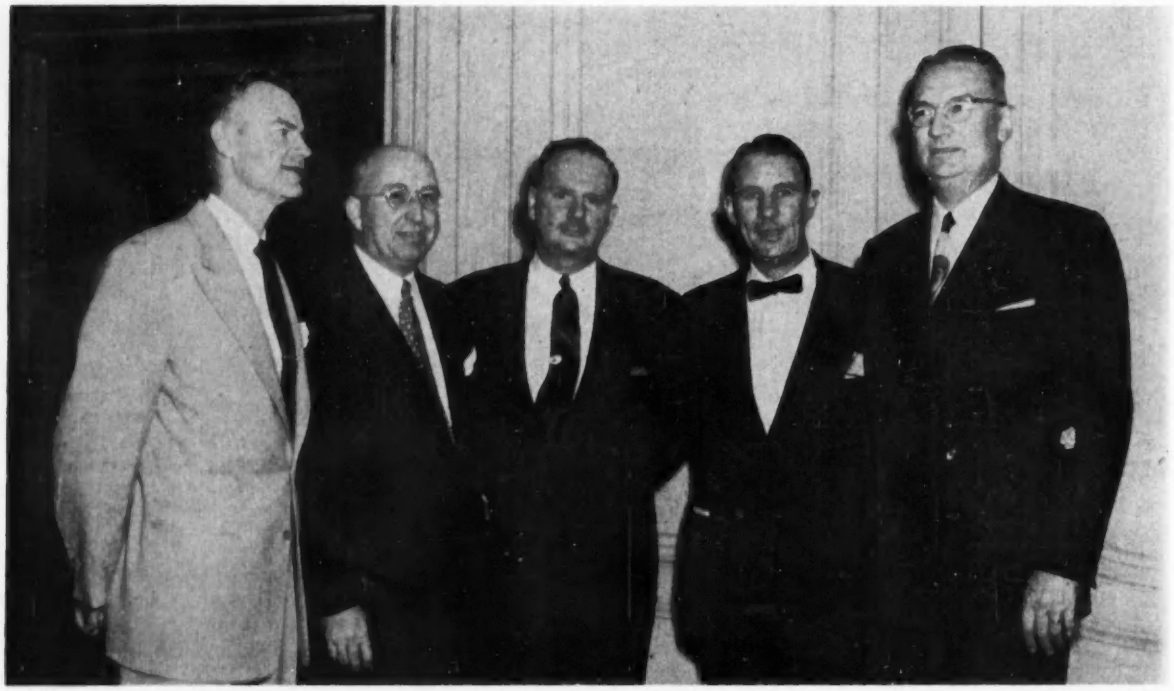
THE steady array of disagreements paraded at the 1953 Transportation Meeting emphasized a long-known and oft-forgotten concept: Automotive design must always be a compromise. The best the designer can produce is a product strong on the features most of his customers want. He's likely to settle for less-than-perfection on qualities where most users will agree with him.

And while users keep suggesting compromises, the threatening shadow of state laws towers over both designer and user—demanding compromises palatable to neither. "It's getting so that commercial vehicle designers need a legal as well as an engineering training," one engineer opined.

It doesn't seem to matter, either, whether the product is a muffler, a power steering device, a vehicle electrical system, or a whole motor truck. The combination of user-needs and state regulations cry "Compromise" to the designers at every turn.

The differences of engineering opinion emphasized throughout the sessions could usually be

Transportation Meeting's Big Five



Here are five men who played a large part in producing SAE's most successful Transportation Meeting. Left to right, they are: Vincent Ayres, vice-chairman for meetings of the Truck & Bus Activity; SAE Vice-President for T&B, N. R. Brownyer; E. D. Hendrickson, who was general chairman of the meeting; Robert Gardner, vice-chairman for meetings of the Transportation & Maintenance Activity; and SAE Vice-President for T&M, O. A. Brouer

to Meet Varied Needs of Users

traced to the specific needs and objectives of the commentator. Those who agreed about a particular design objective didn't differ too strongly about how to reach it.

Noise as an Example

The 5-paper Noise Symposium illustrated many of these points. A Man from Mars might easily have decided after attending that a perfect muffler doesn't exist—and maybe never will. He might have deduced a muffler should be low in cost, create no back pressure, be light in weight and small in size,—and eliminate noise, no matter how the driver "gunned" his engine. He might have seen the word "compromise" written across every muffler design and muffler experience related.

But he would have sensed, too, that elimination of muffler noise is but part of the truck noise problem—and that the whole problem is both complex and far from solved.

Operators, vehicle makers, and muffler manufacturers did agree, though, on three points:

1. Truck noise is a mutual problem in which they are all involved, all trying to solve.

2. Something must be done VERY FAST by industry to give state vehicle administrators some uniform means of administering state laws against "too noisy" trucks. If industry doesn't act quickly, the state administrators will act on their own under growing public pressure—with or without a sound basis for their actions. (One state right now, it was said, is ruling trucks off its roads on the basis of recordings on an ordinary "applause meter.")

3. Much additional basic research is needed before measuring instruments can be agreed upon. Despite progress recorded at this meeting toward practical instrumentation, there was no specific agreement about what kind of noise is bad noise to start with.

Some engineers felt that the immediate, fast job and the long-term research job may have to be undertaken by different groups to reach the two very different objectives.

Certain compromises in muffler design, it was clear, arise because some ways of eliminating noise bring with them undesirable effects. Mentioned were higher costs, greater weight, larger size, and decreased engine efficiency through increased back pressures. Each discusser, it seemed, recognized the need for compromise in all of these areas—but, naturally, tended to favor a particular compromise fitted to his peculiar needs.

Several in the noise discussion suggested reduction of muffler noise to the level of other truck noises as a fairly good rule-of-thumb solution to the noise problem. Others objected that this was no solution at all; that it could mean simply raising other truck noises to objectionable levels.

Power-Steering Designs Affected

Power steering discussion at the meeting indicated similar design-use problems leading to compromise solutions.

Various ways to reach power steering's ease-of-handling objective were argued. But, as one engineer said, "There are differences of opinion as to which features are most meritorious and least detrimental. That's one of the facts which makes the subject of power steering so interesting at this time."

One speaker showed specificially how power steering on trucks can make possible more weight distribution to the front axle—and thus permit, within existing state laws, greater payloads.

Air Springs Commended

The design-is-a-compromise theme came out, too, in a discussion of the merits and limitations of some relatively new air spring suspensions—and of more conventional leaf spring designs.

The new air spring suspensions got an affirmative nod from a user with 45,000 miles of experience on each of 100 "bellows-equipped" city buses. . . . And generally favorable comments came, also, from an over-the-road bus operator who has run up about 250,000 miles of test experience on 400 buses. (These same buses, he said, will cover an aggregate of something like 6,000,000 miles a month. This experience, the operator said, will be "the acid test of the basic design as well as of the details of construction.")

These operators agreed that the air springs develop in practice the good results predicted by the

Around the Transportation Meeting

Noised about during the Noise Symposium:

By **L. H. Billey**, Donaldson Co.—"Engine designers have learned to get increased power from engines of a given size. But muffler manufacturers haven't learned how to increase the specific output of an exhaust pipe."

"We don't really know how to measure back-pressure. Using a manometer is like putting hair tonic on a wig; or making love to an old maid. If you're successful, she won't be an old maid."

By **Merrill Horine**, Mack Mfg. Co.—"A noise instrument makes a liar out of your ears."

★ ★ ★

Jim Booth, introducing his paper about steering arrangements, told this one:

Two drunks were driving along an open highway, arguing as to whether they were going toward the city or away from the city.

"We're going toward the city—and I'm sure of it," one drunk insisted.

"How can you be sure?"

"I'm sure we're getting nearer the city," came the reply, "because we're hitting more and more people."

★ ★ ★

SAE President **Robert Cass** was a constant attendant at the Transportation Meeting sessions—and enlivened discussion more than once.

★ ★ ★

At the T&M Activity Committee meeting it was announced that **Robert Gardner**, T&M's vice-chairman for meetings, has formed Automotive Operations Associates at 53 State St., Boston, Mass. The new organization will be consultants on automotive fleet problems.

★ ★ ★

Next year's Transportation Meeting is scheduled for Boston . . . and in 1955, St. Louis has the nod from both the T&M and the T&B Activity Committees. . . Both Activity Committees met on Nov. 3—and came to an agreement on St. Louis after warm debate in each case about possibilities of various sites. . . At his T&M Activity Committee meeting, Vice-President **Orville Brouer** had 19 in attendance, while 19 members of T&B Activity Committee were in action at Vice-President **Nelson Brownyer's** meeting.

tests described at the meeting by the designer. The drivers like them, shop men comment favorably, more uniform tire wear results—and no noise is deflected into the bus, the operators said.

Steel spring men countered with questions as to comparative original costs. But they tended to applaud the new air spring designs as a spur to steel-spring suspension designers to find ways to eliminate excess and variable interleaf friction and otherwise improve their units.

Practical Compromises Common

The steering-arrangements discussion at this meeting was chiefly a thorough and illuminating description of a great variety of steering systems set up to meet varied vehicle needs. The different designs were clearly keyed to the use-requiremnts of the vehicles to which they were to be adapted.

At another session, the vehicle designer was urged to compromise or modify his constructions as necessary to meet human needs of drivers. He was advised, for example, to "consider human body size and capabilities in the design of instruments, vehicles and working areas." Medical test data can be of help to the designer in many of these human-design relationships, it was said.

COE Designs Analyzed

Compromise appeared active also in designers' efforts to overcome the inherent disadvantages and make more widely available the important advantages of COE trucks.

Every one of four speakers touched on the search for practical compromises. One mentioned as a detail example that, within present laws at least 4-in. clearance between the rearmost part of a COE cab at its centerline and the front corner of the trailer is desirable when both vehicles are on level ground. Then, he suggested three ways to adjust that clearance: by moving the fifth wheel along the lines of the frame of the tractor; by moving the trailer kingpin with relation to the front of the trailer; or by designing a radius into the front corners of the semi-trailer. . . . He concluded: "As usual, practice is a compromise between these possibilities."

Another COE commentator talked of accessibility as one of five inherent COE disadvantages. Progress is being made, he said, and named, as examples, the tilting cab and a number of alternatives, including removal of a scuttle within the cab, swinging open the front sheet or panels, and taking out the seats, floorboards, and toeboards—all or some of them." But, he concluded: "Too often the means adopted to achieve accessibility have introduced other problems connected with sheet metal maintenance, insulation, fume-tightness, and convenience of controls." A third speaker echoed these sentiments about accessibility improvements, saying: "All designs have their individual merits, but some designs create new problems."

Some of the interesting statements made by each of the various authors are included in the briefs which follow. Later issues of SAE Journal will contain an abridgment of each individual paper and of the discussion which took place in connection with it.

Highlights from Transportation Meeting Papers . . .

Quieting Vehicle Engine Exhaust Noise

Replacement muffler vendors usually stress two features of their products. They stress either low back pressure or heavy-duty construction, or both.

The low back pressure muffler is usually a "gutless wonder" with very low back pressure and a very high noise level. The heavy-duty construction mufflers often are heavy and noisy. . .

. . . **Richard L. Hardgrove,** The Liberty Highway Co., "Commercial Vehicle Exhaust Noise—Its Cause and Cure . . . Problems of Truck Operator."

A survey of Middle West and West Coast truck noise showed that West Coast trucks average about 55% louder than those of the Middle West. Of the Middle West trucks, 35% were found to be between 81 and 113 sones; 40% of the West Coast trucks were between 114 and 160 sones at a distance of 50 ft. (A sone is an arithmetic unit rather than a logarithmic unit like the decibel. So a sound of 175 sones is about seven times as loud as one of 25 sones). . .

. . . **D. B. Callaway,** Armour Research Foundation, "Measurement and Evaluation of Exhaust Noise of Over-the-Road Trucks."

Increasing exhaust back pressure produces a horsepower loss in both naturally aspirated and supercharged engines. (The latter is less sensitive.) Since this power loss is due in part to a decrease in volumetric efficiency, an increase in exhaust smoke and exhaust gas temperature will accompany it. The engine's brake specific fuel consumption also will go up. . .

. . . **M. L. Fast,** Cummins Engine Co., "Exhaust Noise and Back Pressures versus Engine Operation."

If present noise-measuring instruments are used in conjunction with a group of listeners forming a jury, the agreement between meter readings and jury judgment would coincide for only about 60% of the tests. The jury is adversely affected by high frequency noise, or, more seriously, influenced by intermittent noises. These cannot be measured by instruments. . .

. . . **B. F. Jones,** Autocar Division, The White Motor Co., "Commercial Vehicle Exhaust Noise—Its Cause and Cure from the Vehicle Manufacturer's Standpoint."

You can understand some of the noise problems confronting the muffler design engineer when you consider that:

- The exhaust gas leaves the engine cylinder at something like 50 psi above atmosphere.
- This excess pressure must be reduced to 0.00001 psi to keep it from being objectionable.
- And this must be done without any appreciable loss in horsepower. . .

. . . **C. E. Nelson,** Nelson Muffler Corp., "Commercial Vehicle Exhaust Noise—Its Cause and Cure."

Power Steering

Take the case of a 30,000-lb-GVW truck trying to negotiate a 300-ft radius proving ground turn banked for 10 mph. At 50 mph, the driver is unable to exert enough force at the wheel to negotiate the turn with manual steering! But he can do so with a 24-lb load on the wheel with power steering. . .

. . . **T. H. Thomas,** Bendix Products Division, Bendix Aviation Corp., "Easier Driving with Power Steering."

Front axles, in most cases, carry comparatively little payload. In fact it's not feasible to increase the front-axle load to the maximum allowable in many states because of driver resistance to the greater steering effort needed. By adding power steering and redesigning the chassis so that more chassis weight overhangs the front axle, the payload of trucks in most cases will be increased 500 to 1000 lb. . .

. . . **S. G. Johnson,** International Harvester Co., "Greater Payload with Power Steering."

continued on next page

Serving as **chairmen of technical** sessions at the Meeting were:

R. C. Wallace, Diamond T Motor Car Co.
H. L. Willett Jr., Willett Co.
E. B. Ogden, Consolidated Freightways, Inc.
W. A. Jensen, Reo Motors, Inc.
C. A. Lindblom, International Harvester Co.
O. A. Brouer, Swift and Co.

For **reports on the discussion** at technical sessions, SAE is grateful to:

E. A. Comfield, Diamond T Motor Car Co.
G. W. Johnson, Bowman Dairy Co.
L. C. Kibbee, American Trucking Associations, Inc.
H. G. Ingerson Jr., Reo Motors, Inc.
Bart Rawson, "Commercial Car Journal"
A. W. Neumann, Willett Co.

Transportation Meeting attendance topped 500 before the last session on Wednesday afternoon. Every session pressed the capacity of the Conrad Hilton's Tower Room. Meeting started on Monday, Nov. 2 and closed on Wednesday Nov. 4.

More Highlights
From Transportation Meeting Papers . . .

Amps and Volts

There is a definite place for both a-c and d-c electrical equipment in motor vehicles. The selection depends on the application and requirements.

For example, on highway trucks with electrical loads of about 35 amp, the 5-amp d-c unit properly installed will give satisfactory life for at least 100,000 miles. In this type of operation, d-c equipment is cheaper than a-c and easier to maintain. But on buses equipped with fluorescent lights, a-c equipment is definitely advantageous. That's true of installations where output is required at both very low as well as very high speeds. In these cases, the a-c alternator doesn't have to contend with commutation troubles you might get with d-c equipment. . .

. . . **J. H. Bolles,** Delco-Remy Division, GMC, "Motor Truck Electrical Equipment."

Air Springs

Resistance to transmission of high frequency vibrations through air and rubber is much greater than through steel. You can get an indication of this by assuming the resistance of air as 1.0. A like coefficient for rubber is 0.002 and for steel, 0.00001. Please note that this does not imply that a steel spring suspension is 100,000 times, or even 500 times as noisy as the air suspension.

The only provable statement is that the air suspension is quite noticeably more quiet than a leaf spring suspension in an otherwise smaller vehicle. . .

. . . **H. E. Fox and D. J. LaBelle,** GMC Truck & Coach Division, General Motors Corp., "Motor Coach Suspensions."

Machines Tailored to Man

It seems reasonable to require that machines be designed from the man outward, with the instruments and controls considered as extensions of his nervous system and body appendages. This implies that machines and working areas must be built around the operators, rather than placing them in a setting without due regard for their requirements and capacities. . .

. . . **Dr. Ross A. McFarland,** Harvard School of Public Health, "Human Engineering: A New Approach to Driver Efficiency and Transport Safety."

Truck & Bus Steering

In commercial vehicles, especially the larger ones, the wheel fight or shimmy problem can be more serious than in a passenger car design. The heavy mass from the rotating front wheel, if disturbed from its path by incorrect geometry during a road bounce, results in a gyroscopic component at right angles to the path of the impact. That causes serious wheel fight. . .

. . . **James H. Booth,** Thompson Products, Inc., "Steering Arrangements and Ball Suspension Possibilities for Commercial Vehicles."

How COE Stacks up with Users, Designers

The cab-over-engine tractor offers the only solution for a sleeper tractor that can haul a 35-ft trailer and still not exceed 45 ft for the overall length of the combination. That's because the COE tractor can be built with a sleeper cab and still not be longer than 86 in. from the front of the bumper to the back of the cab. . .

. . . **F. S. Baster and C. H. Fager,** The White Motor Co., "Some Design Elements for COE Highway Tractors."

Our shop supervisory people say that it is easier to do any work to the top of the engine (such as changing heads and fuel filters and setting valves) on cab-over-engine equipment than on conventional vehicles. That's because of the ease with which the mechanics can reach the units while sitting on the cab floor.

COE and conventional trucks don't differ with respect to maintenance work on the bottom of the engine. This includes pan, bearings oil pump, and so forth. Most major front engine work, such as timing gears and camshafts would be about the same in both designs since the radiator has to be pulled in both cases. . .

. . . **L. E. Kassebaum,** Consolidated Freightways, Inc., "Fleet Maintenance Characteristics of COE Tractors and Trucks."

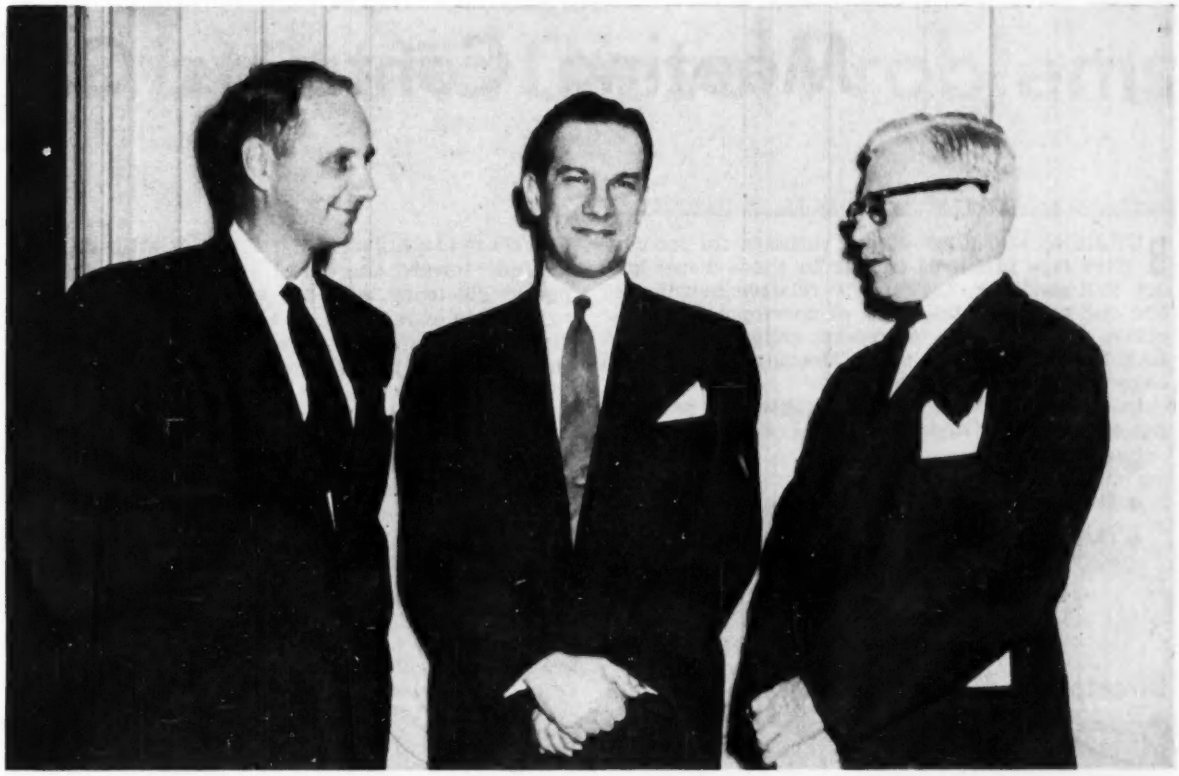
In designing controls for a cab-over-engine tractor, the designer finds himself on the horns of a dilemma. If he aims for driver convenience, he adopts remote controls and runs into a multiplicity of rods, levers, and brackets which interfere with servicing. Yet centralizing such control connections for accessibility may make the controls awkward to handle. . .

. . . **F. R. Nail,** Mack Mfg. Co., "Methods of Overcoming Inherent Disadvantages of COE."

Where states allow a semitrailer longer than 35 ft with 10 more ft for the overall combination, the conventional tractor can do the job without resorting to the full cab-over-engine. The real field for the COE is where state law specifies maximum overall length but does not specify length of individual units within the combination. . .

. . . **Lewis C. Kibbee,** American Trucking Associations, Inc., "The Need for Dimensional and Operating Characteristics of the COE Chassis."

Chicago Meetings Feature Joint Dinner



Just before the joint dinner, Toastmaster Merrill R. Bennett, Dr. John T. Rettaliata, and SAE President Robert Cass get together. Rettaliata was principal speaker

SOME 800 SAE members and guests attending the three SAE National Meetings held at the Conrad Hilton Hotel in Chicago the week of November 2–6 joined in a dinner on Wednesday evening.

The three meetings were:

- SAE National Transportation Meeting, reported on page 58
- SAE National Diesel Engine Meeting, reported on page 64
- SAE National Fuels & Lubricants Meeting, reported on page 68

The dinner featured a speech by Dr. John T. Rettaliata, president of Illinois Institute of Technology. SAE President Robert Cass spoke briefly, and Chicago Section Chairman Merrill R. Bennett served as toastmaster.

Rettaliata urged the business community to give financial support to the private educational institutions. Continuing, he said:

"As a direct benefit, we certainly can list the trained men and women we supply them. Management tasks are becoming increasingly complicated, requiring a wide range of talents and training. It seems only reasonable to expect business and industry to help the colleges train the personnel they eagerly recruit each June."

"Another direct benefit is in the markets education provides business. The more persons we educate, the greater will be the nation's earning power and the greater its consumption of goods."

"Less tangible perhaps but equally important are the indirect benefits corporate management can expect. I firmly believe that maintenance of a free society is one of these."

To their supporters and the general public, the colleges and universities owe assurance that they possess freedom and integrity within their own domain, Rettaliata insisted. "To me," he said, "it is inconceivable that any academic administration would knowingly hire or retain a member of the Communist party. The blind loyalty demanded of a Communist makes him useless as a teacher, for he is incapable of exercising freedom of thought."

Meeting Contrasts Gas

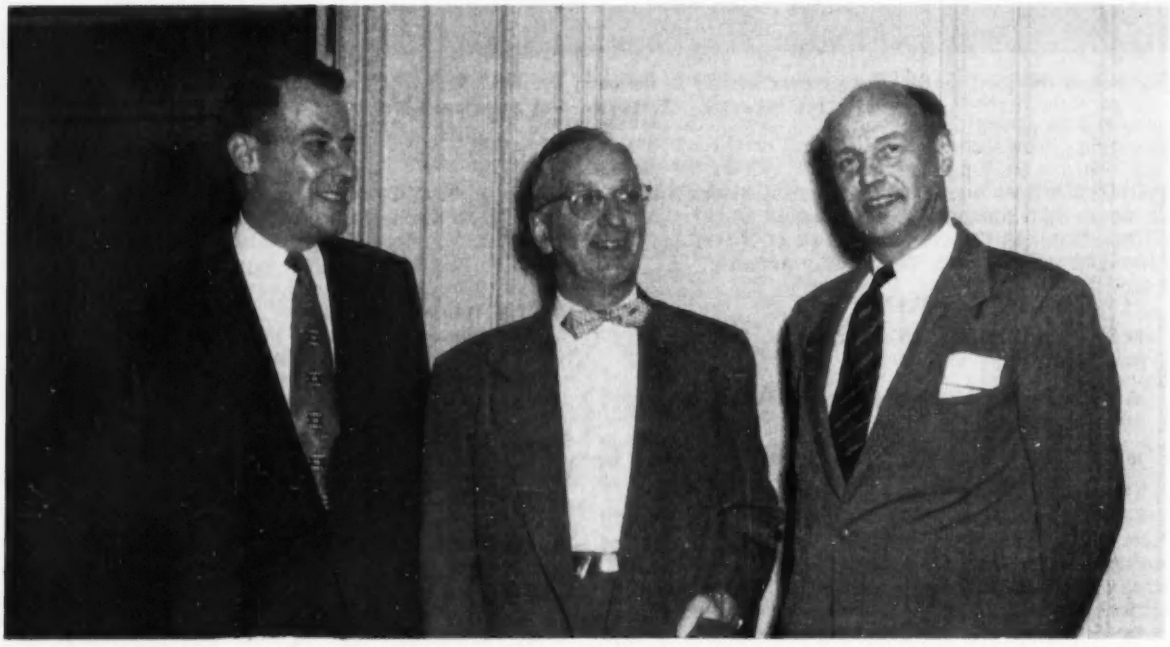
BUILDERS and users of gas turbines for locomotives face problems similar to those diesel men are still studying, despite the relative newness of the one and the high state of development of the other. Such was the impression gained at the 1953 SAE National Diesel Engine Meeting held in Chicago on November 3 and 4.

In both cases the problems discussed at the meeting covered such items as:

- How to increase efficiency.
- Devising better methods of construction.
- Developing new materials—especially for parts subjected to extremely high temperatures.

If there is a difference, it is one of attitude. The attitude toward the diesel appears to be that its power, efficiency, and life will gradually continue to increase as refinements in theory and design are made. With the gas turbine, on the other hand, there seems to be a rather widespread feeling that some drastic solution is needed for its most grievous weakness—low efficiency, especially at idling. An increase in inlet temperature would help, it was said, but it would introduce new problems because of the limitations to the temperatures that present-day materials can withstand. The use of cheap fuel also results in somewhat lower costs. Neither of these is, however, envisioned as the ultimate solu-

Directors of Diesel Meeting



Men who were responsible for the behind-the-scenes planning of the Diesel Meeting are (left to right): J. W. Pennington, vice-president for the Diesel-Engine Activity; A. F. Ochtman, general chairman of the meeting; and H. W. Luetkemeyer, meetings vice-chairman

Turbine and Diesel Problems

tion. Meanwhile, until an appreciable improvement in efficiency is effected, the application of the gas turbine to railroad operation seems to be definitely limited—particularly since most railroads are the possessors of nice, shiny, new diesel engines of extremely high efficiency—and new shops to care for them. Moreover, as one discusser pointed out, the reduction in operating costs effected by going from steam to diesel power is considerably greater than could possibly be attained by converting from diesel to gas turbine. Gas turbine advantages lie in its lightness, its ability to use cheap fuel, as already mentioned, its capacity to accelerate any train that it can start, and its possibilities for decreased maintenance.

Maintenance difficulties are being experienced with the gas turbines, but this is mainly because the units are still in the experimental stage. They must be better understood and more highly refined before maintenance procedures are got under control and settled in a suitable pattern. But afterwards, one discusser asserted, maintenance should certainly be lower than for the diesel. Gas turbines, he pointed out, while not getting any simpler, probably never will approach the very large number of precision parts found in the diesel, most of which reciprocate and are subject to all kinds of wear and breakage.

Diesel Progress

Details were given on two ways of improving the efficiency of diesel engines:

- Increasing the scavenging efficiency—of 2-stroke engines.
- Improving the combustion system.

Since the ability of the 2-stroke engine to produce power depends on the amount of fresh air that can be trapped in the cylinders per unit time, one of the principal objectives of the designer is to learn how to trap reasonable quantities of fresh air, without the expenditure of undesirable amounts of scavenging blower power. To determine how much fresh air is retained—the scavenging efficiency—is not an easy matter, it seems, for there is no direct method of accomplishing this. One fairly simple method was said to be based on a CO_2—O_2—CO analysis of a gas sample taken near the end of the expansion stroke. A semiautomatic impact check-valve sampler was described that appears to be well suited to taking the samples, even by unskilled help. One convenient use of the sampler in the field was reported in discussion to be to determine if the fuel/air ratio of a given design is in a safe operational range under service conditions.

The improved combustion system described at the meeting consists, briefly, of direct injection into an open chamber of "Mexican hat" shape located in the piston crown. A 15-20% higher fuel economy over that of the single-lobe energy-cell type of combustion system previously used in Mack engines was reported for it. One discusser pointed out that smoothness is generally poorer with the open chamber than with the energy-cell system, and that when the former type idles for a long time serious nozzle and piston troubles may occur, as contrasted with the ability of the auxiliary-chamber engine to idle for unlimited time. The author claimed, however, that they had not experienced idling difficulties with the new engine.

Reductions in weight and space occupied while maintaining good life expectancy were said to accrue to the new Packard diesel as the result of such features as:

- Extensive use of aluminum.
- Hard cylinder surfaces having good wear properties.
- Nitrided crankshafts.
- Four valves per cylinder with stellite seating surfaces on valves and seats in the head.
- One-piece cylinder and head assemblies.

The one-piece cylinder and head assembly eliminates the problem of sealing cylinder gas assemblies. One discusser felt that this construction

Session Chairmen and Secretaries

MEN who were responsible for the smooth operation of the sessions and the reporting of discussion are:

Chairmen:

R. T. Sawyer,
American Locomotive Co.

F. G. Shoemaker,
Detroit Diesel-Engine Division, GMC

V. C. Young,
Eaton Mfg. Co.

J. C. Miller,
Cummins Engine Co., Inc.

Secretaries:

W. P. Green,
Armour Research Foundation

Gregory Flynn, Jr.,
Research Laboratories Division, GMC

Vincent Ayres,
Eaton Mfg. Co.

M. L. Fast,
Cummins Engine Co., Inc.

might well initiate a design trend in high-output lightweight engines.

Aside from the high manufacturing cost of the one-piece construction, he said that the main objection has always been inaccessability. He pointed out that this may no longer be a valid criticism now that we have valves, piston rings, and cylinder bores that will operate well over 100,000 truck miles without maintenance. Thus, he continued, the one-piece cylinder design now becomes very desirable, with its elimination of gasket troubles, cylinder and valve-seat distortion from stud loads, and its lighter weight.

Another discusser thought that there might possibly be some difficulty due to deposit formation around the cylinder head, which might freeze it to the block and prevent removal without damage. Such trouble has not been experienced, according to the author, and if it did, he explained that it is not too difficult to force the cylinder past the deposits without any harmful distortion.

Two widely different areas where better materials are being developed were discussed:

- Exhaust-valve material.
- Distillate fuels of improved storage stability.

It seems that while exhaust-valve troubles were classed as only a nuisance a couple of years ago, they are now being given major consideration for correction.

The development of a material that is highly resistant to thermal fatigue, as well as having high strength and resistance to impact fatigue, and possesses good burning resistance (that is, resistance to oxidation) at elevated temperatures appears to be of primary importance.

Several of the materials tested for valves showed real promise, among them N-155, originally developed for jet turbine blades, which gave a 75% improvement in valve life, and Hastalloy X, which showed a 200% improvement in valve life.

One way of licking the valve scuffing problem that was claimed to be giving very encouraging results consists in the use of a new valve guide material capable of operating without lubrication. It was reported that this material, which consists of powdered metals impregnated with dry lubricant, is available to engine manufacturers on an experimental basis.

The development of distillate fuels of improved stability should be greatly accelerated by an extensive Bureau of Mines study of the underlying causes of this condition.

All agreed that this badly needed study is producing important basic information that should lead to more uniformly good diesel and burner fuels.

The program to date has resulted in the formulating of such tentative generalizations as:

- Straight-run fuels are the most stable, catalytically cracked fuels are intermediate, and thermally cracked fuels are the least stable.
- Iron does not catalyze gum formation.
- Copper does catalyze gum formation, especially in the presence of sea water.
- Oxygen is necessary for gum formation.

In discussion it was pointed out that one of the most striking results of the report was on the harmful effects of copper. This effect, it was reported, is also being studied by at least one petroleum laboratory in industry because of field complaints that filter screens in diesel engines and fuel oil burners were restricted by waxy deposits. These field complaints were said to be corrected by taking any of the following steps:

- Remove or convert the copper mercaptans, which make up the waxy deposits.
- Reduce the formation of peroxids by minimizing contact with oxygen.
- Remove the sources of or contact with copper.
- Deactivate the copper chemically.

Some of the interesting statements made by each of the various authors are included in the briefs which follow. Later issues of SAE Journal will contain an abridgment of each individual paper and of the discussion which took place in connection with it.

Highlights . . .

from the Diesel Engine Meeting Papers

Gas Turbine Locomotives

Although the first commercial gas turbine locomotive was placed in service about the same time that the first commercial diesel freight locomotive entered service in 1941, its development has been slow, due principally to the greater metallurgical problems with the gas turbine.

It is evident that the economic possibilities of the gas turbine as developed to date in railroad service will depend on the use of cheap fuel and will, in consequence, be confined to locations where fuel shipping cost is a minimum.

The application of the gas turbine locomotive to our Class I railroads will depend entirely on its economics. If the gas turbine locomotive should prove cheaper to operate than other types, it will prevail. . .

. . . **P. A. McGee**, consulting engineer, "Locomotive Power and Performance Requirements, with Special Reference to Gas Turbine Locomotives."

New Lightweight Diesel

The new family of Packard diesels has such noteworthy features as:

- Extensive use of aluminum to give weight reduction.
- Turbosupercharger providing exhaust heat recovery.
- Hard-surface cylinders to reduce wear and minimize service replacements.
- Nitrided crankshafts to provide maximum endurance strength and maximum journal and crankpin life.
- Four valves per cylinder with stellite seating surfaces on valves and seats in the head.
- One-piece cylinder and head assemblies, eliminating problems in sealing cylinder gas pressures. . .

. . . **M. Ware, R. E. Taylor, and J. Witzky**, Packard Motor Car Co., "The New Packard Lightweight Diesel Engines."

Exhaust Valve Breakage

Over 60% of the diesel-engine manufacturers reviewed reported breakage to be the outstanding valve trouble.

Valve breakage may be due to impact fatigue or thermal fatigue. Impact failure generally occurs where stress raisers are present to act as nuclei for the failure. Thermal fatigue is the most frequent cause of valve breakage. It may originate at the valve head outside diameter or on the valve face or show up as one or more radial cracks.

Due to the many factors affecting the performance of an exhaust valve, it is impossible to prescribe a universal valve design or material. . .

. . . **J. A. Newton**, Thompson Products, Inc.; **J. L. Palmer**, Lubrizol Corp.; and **V. C. Reddy**, GM Detroit Diesel Engine Division, "Factors Affecting Diesel Exhaust Valve Life."

Better Burning for Diesels

The new Mack diesel engine has direct injection into an open chamber head with a "Mexican hat" recess in the piston crown.

This combustion chamber gives excellent combustion as the result of swirl, squish, proper rate of injection, and spray pattern.

Engines embodying this new combustion system show:

- Fuel economy improvement of 15% and better.
- Virtually smokeless operation at reduced load, minimum smoke at full load. . .

. . . **Bruno Loeffler**, Mack Motor Truck Corp., "Development of an Improved Automotive Diesel Combustion System."

Scavenging 2-Stroke Engines

It is futile to attempt to achieve large gains in output of 2-stroke engines merely by raising the scavenging ratio. As scavenging ratio is increased, a point is soon reached where the resultant increase in scavenging efficiency is too small to justify the added mep required by the scavenging pump. This conclusion holds even for through-scavenged designs, which have a so-called "supercharging period," that is, a lag between exhaust closing and inlet closing.

The only way any considerable gain in imep can be achieved in 2-stroke engines by supercharging is to raise *exhaust* pressure as well as inlet pressure above that of the surrounding atmosphere. This suggests the use of an exhaust turbine. . .

. . . **C. F. Taylor and A. R. Rogowski**, Massachusetts Institute of Technology, "Scavenging the 2-Stroke Engine."

More Middle Distillates

During the last 10 years the demand for all petroleum products has increased, with a disproportionate rise in demand for the middle distillates, including diesel fuel, jet fuel, household burner fuel, and catalytic cracking charge stock. A straight-run distillate is preferred for all of these products; but, unfortunately, the supply has not been adequate to meet the increased demands. For some uses it has been necessary to make up the deficit by blending catalytically cracked stocks with the straight-run distillate. This blending has complicated the storage problem, as some of these blends deteriorate under normal storage conditions. . .

. . . **F. G. Schwartz, C. C. Ward, and H. M. Smith**, Bureau of Mines, "Studies on the Storage Stability of Distillate Fuels—Results of Storage Tests."

Harry Mougey Honored by Lubrication

Harry C. Mougey (right) reads the certificate of honor which J. L. McCloud (left) has just presented him on behalf of Subcommittee B—Engine Lubricants of the SAE Fuels and Lubricants Technical Committee. This was one event in what turned out to be practically a Harry Mougey Week. Mougey, a former chairman of the Committee, is retiring from chairmanship of the Subcommittee as well as from General Motors

HARRY C. MOUGEY was honored for his long service in the solution of automotive lubrication problems at a session of the SAE National Fuels and Lubricants Meeting and at two committee luncheons preceding it.

The occasions marked Mougey's retirement on November 1 from General Motors, where he had been Technical Director of the Research Laboratories Division, and his retirement from SAE committee work. He presented a paper titled "Forty Years of Progress in Automotive Lubrication—A Look into the Future" before 600 well-wishers at the Thursday afternoon session of the Meeting.

A parade of discussers marshalled by Session Chairman H. L. Moir added their reminiscences to Mougey's. Those heard from included:

E. W. Upham
Ludlow Clayden
J. L. McCloud
K. G. MacKenzie
Neil MacCoull
G. A. Round
J. P. Stewart
E. W. Dean
A. J. Blackwood
H. F. Bryan
C. G. A. Rosen
L. A. Blanc
D. P. Barnard
C. J. Livingstone
H. R. Wolf
C. M. Larsen
F. A. Suess
M. D. Gjerde

Almost every discusser had a story to tell about Harry's good-natured needling in the interests of better lubricants. J. L. McCloud recalled that at their first meeting, Mougey showed him a laboratory report on a substance which had been tested for all the properties then commonly specified for lubricating oils. McCloud granted that the substance would qualify on the basis of the requirements his lab laid down for engine oils. Mougey then told him the substance was molasses! Right there he won a convert to his ideas on how oil should and should not be specified.

Cliff Larsen presented Mougey with an historic cane. Larsen explained that at a meeting in 1946, he had mentioned seeing the world's first diesel engine at the Columbian Exposition of 1893 in Chicago. Mougey, Moir, and others figured anyone who could remember that far back needed a cane and accordingy presented one to Larsen. Larsen returned the cane to Mougey as the first of the group to retire.

Reverting to a more serious vein, Larsen also reminded the audience of Mougey's part in gaining acceptance of the type of lubricant classification now used, in place of the chemical and physical limits once specified. And Larsen recalled that Mougey made a motion back in 1934 to adopt 10W and 20W as part of the SAE classification. He was voted down then, but 16 years later these two viscosity numbers were added.

Gjerde noted that Mougey was chairman of the Lubricants Division of the Society's Standards Committee for the six years from 1921–1926 and vice-chairman for the 20 years from 1927–1946. Ever since the Fuels and Lubricants Technical Committee was established in 1947, Mougey has been chairman of its Subcommittee B on Engine Lubricants.

Dean and Blackwood presented a joint discussion in the form of a conversation supposedly re-

Men

corded on the golf course. While the record played, pictures of the two men blasting their way out of sand traps and at other stages of a recent game flashed on the screen.

"You can't see the flag from here," said Dean to Blackwood at one point, "but it's there all the same—just like some of Harry's objectives."

Discussers jokingly referred to the disagreements they had had in the past with Mougey. But they agreed that his work had contributed greatly to the solution of many of the lubrication problems that have arisen during the past four decades and that his prodding had stimulated many improvements in lubricants.

Mougey's steady insistance on publishing results of investigations without regard to possible commercial implications drew him praise for his technical integrity.

He was lauded also for his loyalty to General Motors, the company with which—together with its predecessor, Dayton Metal Products Co.—he had been associated since 1917.

Besides the certificate shown opposite, Mougey received a plaque from the Coordinating Lubricant and Equipment Research Committee. Mounted on the plaque were two pistons from a Lauson test engine. One piston was dirty—"before Mougey"—and the other bright—"after Mougey." That one piston was bright and the other showed the effects of test running was a special tribute to Mougey. A few days before the presentation, it was discovered that the jeweler who made the plaque had cleaned and polished the one blackened piston til it shone like new. It took fast work on the part of many of Harry's admirers to turn up a second suitably begrimed piston and mount it in time.

After the festivities, Harry and his wife started out for their home at San Rafael, Cal.

F & L Meeting Treats Oil Progress, LPG, and Knock

FOR the benefit of their mutual customer—the public—the automotive industry and the petroleum industry traditionally work together to solve fuels and lubricants problems before they become urgent commercially.

The SAE National Fuels and Lubricants Meeting held November 5 and 6 in Chicago devoted a whole session to commemorating this tradition and to honoring a man who has done much to establish it, Harry Mougey. Three other sessions served as vehicles for exchange of information among oil men, engine men, and vehicle operators.

Recounting advances in lubrication attained through cooperation between the two industries, Mougey brought up the crankcase dilution and corrosion problems of the 1920's and early 1930's. The heavy ends of the gasoline escaped burning and slid down the cylinder walls into the crankcase. Also, water and other products of combustion entered the crankcase and diluted the oil. The heavy ends reduced crankcase viscosity alarmingly. The water and combustion products corroded piston rings and cylinder walls.

Oils of higher and higher viscosity were used to compensate for the dilution. By 1932, crankcase oil viscosities averaged around SAE 40. At this point, joint action solved the dilution problem. The oil industry began to supply fuel with less of the heavy ends. And the automobile industry added thermostats and crankcase ventilation.

The corrosion problem hasn't been solved completely even yet, Mougey noted. He urged development of a test to evaluate crankcase oils in respect to their ability to decrease corrosion of iron and steel parts in service.

He proposed also that investigators work out a new test for evaluating extreme pressure properties of crankcase oils—a test suitable for research and inspection work. He mentioned two tests under consideration at GM. One involves production oil-pump and distributor gears and camshafts. The other is a modification of the L-4 test in which a Chevrolet Powerglide engine figures in place of the usual Chevrolet engine. The Powerglide engine is used because it incorporates hydraulic valve lifters, which have given trouble with some EP lubricants.

Satisfied Customers

That the cooperation between the oil and automotive industries does benefit customers was evidenced in a session on liquefied petroleum gas (LPG) as a bus fuel. Low-priced, sulfur-free propane and high-compression engines designed specially to use propane are giving good service. Operators of bus lines in Chicago, Wichita, and San Antonio praised LPG buses for their lack of odor

and smoke and their savings on fuel and maintenance.

All three operators reported that there is no crankcase dilution or sludging, even with protracted idling. Wear rates are much lower than those of diesel or gasoline engines, so that LPG engines can run maybe even 400,000 miles between overhauls. These advantages more than compensate for the investment in LPG storage and handling facilities.

Even that investment need not be high, a discusser from Fort Wayne pointed out. For their 36 LPG buses, his company installed two 1000-gal propane storage tanks at a cost of about $2500 and leaves the rest of the fueling up to the local LPG dealer. He handles it at a charge of about 1 1/3¢ per gal.

Discussion brought out that LPG buses have not proved most economical in all the operations where they've been compared with other types. Harrisburg found that fuel costs ran high with LPG and so did maintenance charges, due in part to valve-burning troubles.

The consensus seemed to be that, in general, LPG can't compete cost-wise with diesel and gasoline operation in areas like northeastern United States where there is no excess of propane and where it would have to be brought in by tank car. But where the per gallon price of LPG is 5¢ or more below the price of competing fuels, the trend toward LPG will continue.

Questions on the effect of propylene in LPG on engine cleanliness prompted disclosure that Wichita is now running three buses on propylene and will compare results with buses run on pure propane. Propylene, it was explained, is sometimes found in LPG obtained from refinery operations.

Twenty-nine oil companies and car manufacturers cooperated on the 1951 and 1952 antiknock requirements surveys conducted by the Coordinating Research Council, of which SAE and the American Petroleum Institute are sustaining members. Analysis of test results, it was reported, indicated that octane number requirements of the post-war car population did not change between 1949 and 1952. There were no significant differences in requirement among cars in the Eastern, Central, and West Coast areas of the United States. Maximum requirement increases throughout the initial 5000-6000 miles, the analysts found.

Oil suppliers, engine manufacturers, and university laboratories are continuing to study knock problems, the meeting showed. Papers were presented on knock testing methods and on techniques for basic combustion studies as well as on an electron microscope study of detergent oil.

Thanks to the four session chairmen, F. E. Selim of Phillips Petroleum, H. L. Moir of Pure Oil, J. B. Duckworth of Standard Oil of Indiana, and W. G. Ainsley of Sinclair Research Labs, sessions kept up a brisk pace and discussion was lively. On hand at each session to report the impromptu discussion for SAE publications was one of the four session secretaries: C. S. Hansen of Pure Oil, F. A. Suess of Continental Oil, H. R. Taliaferro of Standard Oil of Indiana, and Andy Lenz Jr. of Sinclair Research Labs.

Highlights from each paper follow. Complete papers are available in preprint form from the SAE Special Publications Department at 25¢ each paper to members and 50¢ to nonmembers. Future issues of SAE Journal will treat each paper in more or less abridged form.

40 Years of Progress

I think we can all be proud of the progress we have made in the last 40 years. And as a result of the cooperation between the automotive industry and the oil industry, I am sure that the progress we will make in the next 40 years will continue to benefit our mutual customer, the public. . .

. . . **H. C. Mougey,** General Motors Corp., "Forty Years of Progress in Automotive Lubrication—A Look into the Future."

LPG for Buses

Our LPG buses are very popular with the riding public and with drivers. When clubs charter buses, they invariably ask for "one of the new propane buses." Drivers like the buses because they have good acceleration and no fuel odor. . .

. . . **J. N. Jobaris,** Chicago Transit Authority, "Chicago Transit Authority Reports on Propane."

We disassembled one of our propane bus engines that was 3½ years old and had run 230,000 miles, and measured the wear. Here's what we found: Maximum cylinder wall wear was 0.005 in., 1½ in. from the top. Camshaft wear was less than 0.001 in. Valve stems showed no measurable wear, and seats were in perfect condition. Main bearings were standard size, and connecting rod bearings were 0.001 in. undersize. . .

. . . **J. E. Ebinger,** Wichita Transportation Corp., "Three Years of City Bus Operation with LPG Fuel."

Fuel savings alone have paid off the cost of our LPG storage facilities (which still have 20–30 years of life) plus the cost of converting our fleet to propane. Savings on servicing, maintenance, and oil are an added bonus. We are most enthusiastic about propane. . .

. . . **J. H. Powell,** San Antonio Transit Co., "Making Cents with LPG."

Anti-Knock Requirements

In the 1952 anti-knock requirements survey, it was found that maximum requirements for one 1952 make in which a manual shift transmission was used were approximately four octane numbers higher than for identical models using a torque-converter transmission. This is probably due to the fact that the torque-converter transmission does not permit full-throttle operation at low engine speeds where maximum knock occurs with the synchromesh transmission. . .

. . . **H. W. Best,** Yale University, **Leonard Raymond,** Socony-Vacuum Oil Co., Inc., and **R. K. Williams,** General Motors Corp., "Anti-Knock Requirements of Passenger Cars—1951–1952" (Report of the Coordinating Research Council).

Weather or Knock

In one of the makes used in our study, weather and its associated

Kenneth Boldt, Frank Suess, and Hugh Hemmingway make a last-minute check on plans the night before the Fuels and Lubricants Meeting began. Boldt is meetings vice-chairman and Suess is vice-president for the Fuels and Lubricants Activity. Hemmingway was general chairman of the Meeting

variables changed the engine octane number requirement by 15 octane numbers. This might well indicate that some of the wide variations in requirement reported in the past among cars of the same make and model were due to variations in test conditions rather than variations among the cars. . .

. . . **R. I. Potter and E. H. Scott,** The Standard Oil Co. (Ohio), and **H. J. Gibson and G. W. Stanke,** Ethyl Corp., "Weather or Knock."

Precombustion Reactions

To study the effects of precombustion reactions on engine knock, two CFR engines were set up in series. The first was motored; the second was fired. The fuel-air charge entered the first engine and was compressed but not fired, and then expanded and exhausted into a manifold leading to the intake port of the fired engine. Test results showed: (1) Thermoneutral reactions occurring in the fuel-air mixture produce strong proknock materials. (2) Precombustion products from later exothermic reactions are not strongly knock inducing. . .

. . . **J. M. Mason Jr. and H. E. Hesselberg,** Ethyl Corp., "Engine Knock as Influenced by Precombustion Reactions."

Taking Gas Temperature

Compression and end-gas temperatures can be measured by means of iodine absorption spectra. The iodine vapor is injected ahead of the carburetor. Light passes into the combustion chamber where iodine vapor has been introduced and out again through quartz windows and is focused on the slit of a spectrograph. The desired wave length regions of the resulting spectrum are focused on phototubes. Electronic equipment produces an oscilloscope deflection proportional to light absorption at three different wave lengths. Temperatures are computed from the absorption data. . .

. . . **S. K. Chen,** International Harvester Co., **N. J. Beck,** Douglas Aircraft Co., and **O. A. Uyehara** and **P. S. Myers,** University of Wisconsin, "Compression and End-Gas Temperatures from Iodine Absorption Spectra."

Because absorptivity equals emissivity, measurements of absorptivity and radiation intensity from a flame in a narrow wavelength range permit determination of the temperature of that portion of the flame in the light path. "Chopped" light from a molten zirconium arc lamp passes through the combustion chamber onto the entrance slit of a spectrograph. This varying radiation intensity is measured by a photomultiplier located at the sodium wave-length. The decrease in intensity of the "chopped" light is a measure of the absorptivity of the flame. This reading plus the reading taken from the flame alone make it possible to determine temperature. . .

. . . **G. H. Millar,** Ford Motor Co., and **O. A. Uyehara** and **P. S. Myers,** University of Wisconsin, "Practical Application of Measured Engine Combustion Temperatures."

Floccule Size Vs. Deposition

Electron microscope studies show that detergent-additive particles in fresh oil average about 50 Angstrom units in diameter and about 200 Angstroms in length. While large numbers of extremely small particles of detergent plus gums or resin remain individually dispersed in the oil, the rate of deposit formation on pistons is very low. When the particles cluster to form floccules averaging about 1000 Angstroms, the detergent no longer prevents deposition. As the floccules grow, the rate of deposit formation increases, gradually approaching that of a straight mineral oil. . .

. . . **J. B. Peri,** California Research Corp., "An Electron Microscope Study of the Performance of a Detergent Oil."

About SAE

GEORGE W. CURTIS has announced plans to live in Fort Myers, Florida, where he has formed a new company, Curtcraft, Inc. The concern will be closely allied with the farm implement field. Curtis, a familiar figure in the farm implement and industrial bearing field for many years, has retired as Milwaukee division sales manager of The Timken Roller Bearing Co. He was with Timken 33 years.

Curtis

Lessells

JOHN MOYES LESSELLS, former associate professor of mechanical engineering at Massachusetts Institute of Technology, has become president of Lessells & Associates, Inc., a firm of consulting engineers, in Boston.

CHARLES A. LINDBERGH will receive the Daniel Guggenheim Award for 1953 next January 25. The award will be presented at the Honors Night Dinner of the Institute of the Aeronautical Sciences at the Hotel Astor, New York. Lindbergh was selected as the '53 Guggenheim medalist "for pioneering achievements in flight and air navigation."

JAMES C. McCRACKEN has been appointed sales manager for the Detroit plant of Thompson Products, Inc. With Thompson since 1941, McCracken has recently served as assistant sales manager at Detroit.

WILLIAM H. TAYLOR has become director of purchases for Packard Motor Car Co., Detroit. He was formerly general sales manager for Tinnerman Products, Inc., Cleveland.

Taylor

Goodacre

CHARLES L. GOODACRE has been appointed technical manager for Clifford Motor Components Ltd., Birmingham, England. Goodacre was deputy technical manager with the Associated Ethyl Co. Ltd. of London.

GLENN M. BROWN has been named president and general manager of Automatic Steel Products, Inc., Canton, Ohio. Brown was previously president and general manager of Ryerson & Haynes, Inc., Jackson, Mich.

Brown

Harvey

R. A. HARVEY, 1952–53 treasurer of the Montreal Section, has been promoted to the newly created position of vice-president in charge of maintenance, Provincial Transport Co., Ltd., Montreal. He was previously general superintendent of automotive equipment.

RICHARD E. WAINERDI is a graduate assistant at the Pennsylvania State College. He was previously in the Air Force.

HAROLD NUTT has been made vice-president and assistant general manager of the Borg & Beck Division of Borg-Warner Corp. He continues also in the capacity of director of engineering. Nutt is a past chairman of the SAE Chicago Section, and has been director of engineering at Borg & Beck since 1930, having been named vice-president in charge of engineering in 1946.

MELVIN N. OSBORN, formerly project engineer for the Warner Gear Division, Borg Warner Corp., Muncie, Indiana, is now chief engineer of Ashcraft Machine Co., Muncie, Indiana.

GORDON J. KUIVANEN has a research lab fellowship to Wayne University, Detroit. On leave from the Research Laboratories Division, GMC, Kuivanen was previously in the U. S. Air Force.

WILLIAM H. HARRIS, JR. has been elected to the board of directors of the Micromatic Hone Corp., Detroit. He has been vice-president in charge of engineering for the company. Re-elected incumbents are: **KIRKE W. CONNOR, A. J. PRENTICE,** and **HERBERT J. WOODALL.**

Harris

Baird

JOHN H. BAIRD has been promoted to assistant to the vice-presidents in charge of marketing and sales in the Cleveland office of The Lubrizol Corp. Baird has been in charge of sales for the company's Mid-Continent Division in Tulsa, Oklahoma, for the past 14 years. **WILLIAM W. SCHAFER** has now been made Lubrizol's Mid-Continent sales representative at Tulsa. He has been with the company since 1950.

Members . . .

R. F. GAGG, now on the administrative staff of the vice-president, Bendix Aviation Corp., has been named chairman of the real estate committee of the United Engineering Trustees, following completion of his term as president of that organization. (James L. Head of Anaconda Copper Co. has succeeded him as UET president.)

NEIL A. MOORE has been appointed to the newly created position of general manager of the Service Division for Spicer products. Among the important posts he has held are those of vice-president and general manager of the Sealed Power Corp., Muskegon, Mich., and vice-president of Federal-Mogul Service with Federal-Mogul Corp., Detroit. He was vice-president of Production for SAE in 1946.

Moore

Casler

WILLIAM A. CASLER has joined the staff of Stanford Research Institute, Stanford, California, as assistant director of economics research. He formerly was assistant director of research with Armour Research Foundation, Chicago. Casler is a past chairman of the SAE Student Committee and has been active as a member of the Chicago Section Governing Board.

L. R. "MIKE" HACKNEY has become executive vice-president of Transport Air Group, Inc., Washington, D. C. He was previously air cargo specialist for Lockheed Aircraft Corp., Burbank, Calif.

Hackney

Johnson

PYKE JOHNSON is carrying on as a consultant to the Automotive Safety Foundation, following his retirement as president and operating head of the organization last month. He succeeded Paul G. Hoffman as president of ASF in 1942, after having played an important part in the automotive industry for many previous years as executive vice-president of the Automobile Manufacturers Association. He first moved to Washington in 1916 as the AMA representative there. He was the first chairman of SAE's Beecroft Traffic Safety Engineering Lecture Committee and is still a member of that Committee.

CAPT. MARSHALL M. DANA, retired from the Office of Naval Material, Navy Department, Washington, D. C., will be associated with the Department of Diesel and Internal Combustion Engines at North Carolina State College, Raleigh, N. C., where he will do special lecture work and be enrolled in the Graduate School.

HARVEY S. FIRESTONE, JR. is the first executive in the rubber industry whose name has been placed in the Hall of Fame of Distribution. Established by the Boston Conference on Distribution, the Hall of Fame is to honor men and women who have made outstanding contributions in this field over the last 25 years.

Firestone

L. Teetor

LOTHAIR TEETOR has been appointed assistant secretary of commerce by President Eisenhower. The appointment is subject to Senate confirmation when Congress reconvenes next January. Teetor was chairman of the board of the Perfect Circle Co., Hagerstown, Ind. **RALPH R. TEETOR,** president of Perfect Circle, has now assumed, in addition, the chairmanship of the board.

FLOYD L. WILLIAMS is now a member of the technical staff of Hughes Aircraft Co., Tucson. He was previously associate professor of mechanical engineering, Texas Technological College, Lubbock, Texas.

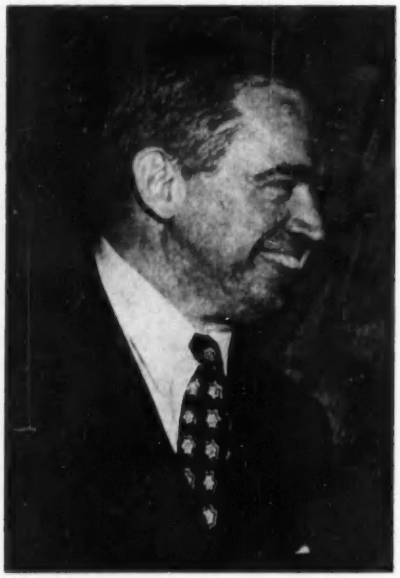
JOSEPH MIHACSI, JR. has joined the Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J. He is instructing Armed Forces personnel in the proper operation and maintenance of the aircraft engines produced by the Wright Aeronautical Division. Mihacsi was formerly with the Kaiser-Frazer Mfg. Co., Willow Run, Mich., as a flight test technician.

Stranahan

Martin

ROBERT A. STRANAHAN, president of Champion Spark Plug Co., and **GEORGE A. MARTIN,** president of Town and Country Motors, have received distinguished service awards from the Automobile Old Timers. The awards are for outstanding service in the automotive field.

D. G. Roos Starts New Activities



D. G. ROOS, president of SAE in 1934, has set up an office as technical consultant at 2106 Monroe St., Toledo 2, Ohio. Roos will currently be technical consultant to Harold S. Vance, president of Studebaker Corp., to Baker Brothers Machine Tool Co., Toledo, and to the Gear Grinding Machine Co., Detroit.

He has been elected to the board of directors of the latter two organizations and also to the board of Formsprag Co. of Detroit.

Formerly associated with Studebaker as vice-president in charge of engineering, and with Rootes Ltd. in England, Roos most recently has been first vice-president of Willys-Overland Motors and, since purchase of that organization by Kaiser-Frazier Corp., has been on loan to the new organization as a consultant. Roos started his engineering career at General Electric under Dr. Sanford Moss and achieved wide success in automobile engineering at Locomobile, Pierce-Arrow, and Marmon before joining Studebaker in 1926.

Sommerville

Whitehurst

S. WYMAN ROLPH, president of The Electric Storage Battery Co., has announced the establishment of two company operating divisions, industrial and automotive.

ROLAND WHITEHURST, vice-president and director, has been appointed general manager of the firm's new Industrial Products Division and **ROBERT L. SOMMERVILLE** is now general manager of the Automotive Products Division. Sommerville was formerly assistant general sales manager.

D. R. SHOULTS is now general manager of the aircraft nuclear propulsion department, Atomic Products Division, General Electric Co. The department was previously known as the aircraft nuclear propulsion project and was under the Aircraft Gas Turbine Division. Shoults, who was manager of the project, now has increased scope and responsibilities.

GUY D. BROGDON has been employed as a representative by Bendix-Westinghouse Automotive Air Brake Co., Elyria, Ohio. He was previously a salesman for Borbein Young & Co., St. Louis, Mo. Brogdon has served on the Membership Committee of the St. Louis Section.

GEORGE E. ROWBOTHAM is now employed as chief draftsman with Niles-Bement-Pond Co., Chandler-Evans Division, West Hartford, Conn. He was technical assistant, design and standards department, Ford Motor Co., Dearborn, Mich.

THOMAS LINDER, JR. has joined Delta C & S Air Lines, Atlanta, Ga., as staff advisor to the assistant vice-president of operations. He was director of engineering and maintenance with the Chicago & Southern Airlines, Inc. in Memphis, Tenn.

ERNEST D. TROUTMAN is now the owner of Auto Electric of Georgia in Atlanta. Secretary of the Atlanta Group, Troutman is also owner of Piston Ring & Parts Co.

GEORGE H. SCHWARZ has joined Power Generators, Ltd., Trenton, N. J., as a mechanical engineer. He was previously a construction engineer in the U. S. Army.

I. P. PAYNE is now manager of sales for the Industrial Power Division of International Harvester Co., Chicago. Payne was formerly assistant manager of sales.

JAMES A. BECKETT is a research engineer for the Fram Corp., Dexter, Mich. He was previously with the Norfolk & Western Railway Co., Roanoke, Va.

EUGENE N. DOUBRAVA is an industrial engineer for the Hughes Aircraft Co., Tucson. He was previously with Thompson Products, Inc., Cleveland, as an industrial engineer.

J. L. WHITE has become senior project engineer for Thompson Products, Inc., Columbus. White was previously sales engineer for Thompson.

H. A. BOLENSKI is now with the Ford Motor Co., Ford International Division, Dearborn, Mich., as director of engineering. He was previously design engineer for GMC, Detroit.

Bolenski

McGregor

GORDON R. McGREGOR, president of Trans-Canada Air Lines, Montreal, has taken office as the ninth president of the International Air Transport Association.

ROBERT M. WHELAN, has returned to the American Bosch Corp. after active duty with the Army Corps of Engineers. He is now district factory representative for American Bosch in Wisconsin, Minnesota, Nebraska, both Dakotas, Iowa and part of Michigan.

W. C. ROBINSON, vice-president of American Bosch Corp., Springfield, Mass., is now heading the project of constructing an American Bosch branch plant in Columbus, Miss. He is devoting all his time to that activity. Robinson was formerly in charge of service sales.

Robinson

Scobie

JAMES A. SCOBIE, formerly assistant director of automotive research for the Pan American Refining Corp., Baltimore, has been transferred to the American Oil Co., an affiliate of Pan American Refining. He is now field technical service engineer with headquarters in Albany, N. Y.

RALPH J. GIMERA is now a mechanical engineer for the Electric Boat Co., Groton, Conn. He was previously a student employee at the Oak Ridge School of Reactor Technology.

RUDOLPH J. JONCZY is now employed by Ford Motor Co. as a product engineering designer in Dearborn, Mich. He was formerly layout and design draftsman for the Federal Motor Truck Corp., Detroit.

DONALD MacDONALD is now Detroit editor of "Motor Trend" Magazine. He was previously a technical writer for Chrysler Corp., Highland Park, Mich.

GRAEME E. MacKINNON is now the owner and operator of MacKinnon Farm Equipment, Donalda, Alberta, Canada. He was maintenance supervisor for Standard Gravel & Surfacing Co. of Canada, Calgary, Alberta.

THEODORE J. WITTORFF has joined the Victor Industry Corp. located at Chico Municipal Airport, Chico, Calif. Wittorff was product engineer for AiResearch Mfg. Co., Los Angeles.

CARLETON F. MAYLOTT, previously assistant chief engineer of research, Scintilla Magneto Division, Bendix Aviation Corp. in Sidney, N. Y., is now at the Cornell Aeronautical Laboratory, Industrial Division, as principal engineer.

RICHARD LUDWIG, formerly with Kaiser Metal Products as a senior layout draftsman, has moved to the Refrigeration & Range Engineering Division of Philco Corp., Philadelphia, as a design draftsman.

ROY C. INGERSOLL, president of Borg-Warner Corp., Chicago, has been appointed chairman of the Manufacture Committee of the U. S. Chamber of Commerce. Ingersoll is a director of the Chamber.

SAE members on the committee are: **LAWRENCE A. HARVEY,** executive vice-president of Harvey Machine Co., Torrance, Calif.; **DANIEL H. KELLY,** vice chairman and vice-president of The Electric Auto-Lite Co., Toledo: and **C. F. NORBERG,** executive vice-president of The Electric Storage Battery Co., Philadelphia.

Ingersoll

Damon

RALPH S. DAMON has been elected a director of the Guardian Life Insurance Co. of America as well as a director of Frontier Industries, Inc. President of Trans World Airlines, Damon was one of the charter stockholders of Frontier Industries. He is the first of the corporation's directorate to be recruited outside of Western New York business circles.

L. L. COLBERT, president of Chrysler Corp., Detroit, has been given the "Texan of Distinction" award of the State Fair of Texas. The award is presented annually to a native Texan who has distinguished himself in industry, science or the arts.

Colbert

Bailey

HARRY BAILEY, recently a vice-president of Rosan Engineering, has left to organize his company, H. N. Bailey and Associates with headquarters in Los Angeles. The new organization represents aircraft component manufacturers, and assists contractors in their dealings with the military.

CLAUDE J. DOUTY has joined the Washington State Institute of Technology. He is a staff engineer for the Division of Industrial Research.

JOSEPH MORVAK is now employed by the Baker-Lull Corp., Minneapolis, as project engineer. Morvak was assistant chief engineer of the Toro Mfg. Corp., Minneapolis.

Changes at Caterpillar

Kimsey

DeCanniere

Junck

In alignment with recent changes in the Engineering Department at Caterpillar Tractor Co. (See September Journal p. 101), two new supervising engineers have been appointed, according to an announcement by chief engineer **J. E. JASS.**

The new appointments are **DONALD E. DeCANNIERE,** who will supervise engineering work with bulldozers and cable controls, and **JOHN A. JUNCK,** who will assume supervision over work on hydraulic controls and tool bars.

These two sections are under the supervision of **WOODROW P. KIMSEY.**

Changes at Tinnerman

Flora

Seitz

Balint

Important organizational changes in the sales and engineering departments of Tinnerman Products, Inc., Cleveland, have been announced.

LAWRENCE H. FLORA, Tinnerman's director of engineering since early this year, has been appointed to the newly-created position of director of sales.

WILLIAM L. SEITZ, formerly in charge of development engineering, has been named chief engineer.

JOHN BALINT has been elevated to the post of new product manager. He was previously in charge of product engineering.

DR. GUSTAV EGLOFF, as representative of the American Chemical Society and of the American Institute of Chemists, presented honor scrolls at a ceremony held at the Tokyo National Museum, Oct. 29. Egloff, who is director of research for Universal Oil Products Co., was a visitor to Japan during the 75th anniversary celebration of the Chemical Society of Japan.

WILLIAM L. MITCHELL has become assistant director of styling for GMC in Detroit. Mitchell was executive vice-president of the Harley Earl Corp., Detroit.

Mitchell

Lenning

MARSHALL EDWARD LENNING has been assigned to the new nationwide Army preventive maintenance program at Fort Eustis, Va. He is concerned with the planning, supervision and operation of training programs designed to improve the organizational maintenance of ordnance materiel used by the Transportation Corps, and is technical consultant on design or material failures. He has been a field engineer for the Chevrolet Division of GMC, and has also served as regional and zone fleet service manager for Chevrolet.

W. J. JOYCE, JR. has been named manager of market research for the Timken-Detroit Axle Division of the Rockwell Spring and Axle Co. Joyce was sales manager of the clutch department for the Dana Corp., Toledo.

Joyce

Dumont

L. F. DUMONT is now process engineer in the Organic Chemicals Department, Manufacturing Division, at the Chambers Works, Penns Grove, N. J. Dumont, who received the Horning Memorial Medal in 1951, was formerly in the Petroleum Laboratory supervising engine research on combustion chamber deposits.

ROYCE C. BLOOD, previously fleet supervisor for the California Truck Rental Co., Los Angeles, is with Fortier Transportation Co., Fresno, Calif., as manager-coordinator of maintenance and operations.

IRVING B. OSOFSKY, formerly senior development engineer in the aerophysics dept. of Goodyear Aircraft Corp., Akron, is now design engineer in the jet division of Thompson Products, Inc., Willoughby, Ohio. He is working on the development and design of new gas turbines and components.

SAE members who attended the ninth National Conference on Industrial Hydraulics last October (sponsored by Illinois Institute of Technology) were: **CARL E. SCHMITZ**, vice-president and director of engineering, Crane Packing Co.; **JOSEPH GESCHELIN**, editor of "Automotive Industries;" **A. J. de MATTEO**, chief engineer, Watson-Stillman Co.; **JULIUS KENDALL**, general sales and service manager, Greer Hydraulics, Inc.; **J. E. JASS**, chief engineer of the Peoria plant, Caterpillar Tractor Co.; **L. PFOST**, chief engineer, Tractor Division, Massey-Harris Co.; **HAROLD L. BROCK**, tractor engineer, Ford Motor Co.; and **W. W. HENNING**, a divisional chief engineer with International Harvester Co.

ANTHONY V. POND has been promoted to project engineer at the Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn. He was liaison engineer.

W. D. ANGST has been named manager of the Conant Works of Thompson Products, Inc. He will be in complete charge of the Conant Plant. Angst had been assistant factory manager of the Michigan Plant until last year when he was made industrial engineer.

DR. THEODORE P. WRIGHT has been appointed chairman of the board of trustees of Associated Universities, Inc. He has served as a trustee for several years and is Cornell University's vice-president for research. Associated Universities, formed by nine eastern universities, administers Brookhaven National Laboratory under a contract with the Atomic Energy Commission.

Wright

Wood

HOMER J. WOOD is now a consultant negotiating contracts in turbomachinery and high speed mechanisms. He is seeking a broad range of activities, trying to avoid remaining entirely in the aircraft field. Wood says most of his time will be absorbed by a few noncompeting companies on a long-term basis.

He resigned from AiRsearch Mfg. Co., Los Angeles, recently where he was assistant chief engineer in charge of turbomachinery.

MORRIS C. ANDERSON has become assistant vice-president in charge of the Plastic Division of Metalcraft Mfg. Co., Phoenix, Arizona. He previously headed the process developing department at Owens-Corning Fiberglas Corp., Newark, Ohio.

L. D. BONHAM, who was assistant chief engineer of Fletcher Aviation Corp., Pasadena, Calif., is now chief engineer. Bonham was 1947-48 chairman of SAE Southern California Section, and currently is chairman of the AMS Commodity Committee on Nonferrous Materials and a member of the Aircraft Activity Committee.

Bonham

Webster

SIDNEY H. WEBSTER has been named manager of the Northeastern District, Jack & Heintz, Inc., with headquarters in New York City. He was formerly assistant to the president, Aviation Engineering Division, Avien-Knickerbocker, Inc., Woodside, N. Y.

WALTER R. LOEWEN, formerly a design engineer for Beech Aircraft Co. of Wichita, Kansas, is now a design staff engineer with Temco Aircraft Corp., Dallas. He is staff engineer in charge of research and development projects in the preliminary design department. He is also consultant on production of landing gears and hydraulic problems.

SAMUEL RANSOM LLOYD has become a project engineer for the Allison Division, GMC. He is writing bulletins and instructions on turboprop engines. He was formerly production foreman for the Electro-Motive Division, GMC.

RAYMOND DE GENNARO, formerly a principal inspector for Republic Aviation Corp., Farmingdale, N. Y., has enrolled at Tri-State College, Angola, Ind.

JOE E. MELLEN is now president and general manager of the Hertz Rent-A-Car System, Lexington, Ky. Mellen was formerly general manager of General Truck Sales, Cincinnati.

ROBERT E. WILSON, who was with the Ford Motor Co.'s Aircraft Engine Division, is now with the research department of the Continental Aviation and Engineering Corp., Detroit.

DEAN BURLEIGH is now directing the activities of Beechcraft's administrative and statistical engineering section. He was project engineer. Burleigh was 1949-50 chairman of the Wichita Section.

Burleigh

Rawdon

HERB RAWDON has taken charge of Beechcraft's commercial projects engineering section. Rawdon, who was formerly assistant chief engineer for Beech, has been an SAE councilor for 1952 and '53. He is also chairman of the Wichita Section.

H. R. HOLMES, JR. is now engineering product designer for the Ford Motor Co., Dearborn, Mich. He was previously chief engineer at Federal Motor Truck, Detroit.

QUENTIN WILCOX, who was development engineer for Martin Motor Co., Eau Claire, Wis., is now project engineer with the West Bend Aluminum Co., Hartford Division, Hartford, Wis.

BENJAMIN B. CRAVENS has been appointed manager of the Industrial Engineering Division of the Airborne Accessories Corp., Hillside, N. J. He was previously staff engineer at Airborne.

JOHN E. DRAKE has been appointed chief engineer of Century Controls Corp., Farmingdale, N. Y. Drake was formerly assistant project engineer, Stratos Division, Fairchild Engineering & Airplane Corp., Bayshore, N. Y. He will be in charge of development of accessory control systems for aircraft being undertaken by Century.

Drake

Hegner

A. B. HEGNER, production manager of Fairchild Engine Division, Fairchild Engine & Airplane Corp., has been named executive assistant to the works manager in addition to his other duties. He has been active in the development of the Aeronautic Production Forum in New York and is currently a member of the Executive Committee planning the 1954 Aeronautic Production Forum.

Spicer Promotions

Stone

Schomburg

Advancement of two members of the sales staff of Spicer Mfg. Division of Dana Corp., Toledo, Ohio, to newly created positions has been announced by **D. D. ROBERTSON**, general sales manager.

W. L. STONE has become transmission and torque converter sales manager and **W. H. SCHOMBURG, JR.**, Universal Joint and Clutch sales manager. Each will have full responsibility for the promotion, development and supervision of sales of the products under his jurisdiction.

Stone has served in the Spicer sales department since 1936. In 1949 he was promoted to the post of assistant sales manager. Schomburg completed a two-year training course at Spicer in 1947 and became a sales engineer, having contacts with the company's passenger car accounts.

SAE Father and Son

T. CLAUDE RYAN and his son, Jerry, took time out to pose for this Father and Son photo. Ryan is president of The Ryan Aeronautical Co., San Diego. He has been in the aircraft business for many years and, as shown above, does his own flying.

Jerry is enrolled at Northrop Aeronautical Institute and belongs to the SAE Student Branch. He will receive his diploma next year.

Cited at University of Michigan

At the University of Michigan's Centennial of Engineering, last Oct. 23, **CHARLES E. WILSON,** U. S. Secretary of Defense, received the honorary Doctor of Engineering degree.

Forty SAE members who received citations for representing "the Michigan tradition in private industry, in government and public service, in research and in education," were: **PAUL CEDRIC ACKERMAN,** executive engineer, Chrysler Corp., Detroit; **CARL FRANCIS BACHLE,** vice-president in charge of research, Continental Aviation & Engineering Corp., Detroit; **STUART GORDON BAITS,** vice-president, assistant general manager, and director, Hudson Motor Car Co., Detroit; **LEE ROBERT BAKER,** director, Chrysler Institute of Engineering, Chrysler Corp., Detroit; **RAYMOND THEODORE BAYLESS,** secretary, Publications Committee, American Society for Metals, Cleveland, assistant secretary, American Society for Metals; **MYRON GOULD BEARD,** chief engineer, American Airlines Inc., N. Y.; **WILFRED A. BYCHINSKY,** chief ignition engineer, A-C Spark Plug Div., GMC, Flint, Mich.; **DARL FRANCIS CARIS,** head, automotive engines dept., General Motors Research Division, Detroit; **JAMES FRANK CHAPMAN,** director of research, ACF Brill Motors Co., Philadelphia; **HARRY ELMER CHESEBROUGH,** chief engineer, Body Division, Chrysler Corp.; **CARL TEMPLAR DOMAN,** national service manager, Ford Motor Co., Detroit; **GLIDDEN SWEET DOMAN,** president, Doman Helicopters, Inc., Danbury, Conn.; **EMIL EMANUEL EBNER,** vice-president, Quaker State Oil Refining Corp., Emlenton, Pa.; **ARTHUR HARLAND FRIES,** works manager, Highland Park Division, Chrysler Corp., Detroit; **DIMITRIUS GERDAN,** chief engineer, Allison Division, General Motors Corp., Indianapolis; **HAROLD JAMES GIBSON,** director, Automotive Products Research, Ethyl Corp., Detroit; **JOHN FRANKLIN GORDON,** vice-president and director, group executive in charge of body and assembly plants, General Motors Corp., Detroit; **WILLIAM HORACE GRAVES,** vice-president in charge of engineering, Packard Motor Car Co., Detroit; **RONALD McKEAN HAZEN,** director of engineering, Allison Division, General Motors Corp., Indianapolis; **ALVIN JOHN HERZIG,** president, Climax Molybdenum Co. of Michigan, Detroit; **HAROLD DERK HOEKSTRA,** assistant director for prototype aircraft development, Office of Aviation Safety, Dept. of Commerce, Civil Aeronautics Administration, Washington, D. C.; **GEORGE JOHN HUEBNER, JR.,** chief engineer of research, and manager, Guided Missile Division, Chrysler Corp., Detroit; **EDWARD AUSTIN HULBERT,** vice-president, in charge of design, Continental Aviation and Engineering Corp., Detroit; **WALTER EDWIN JOMINY,** chief metallurgist, research, Chrysler Corp., Detroit; **C. L. JOHNSON,** chief engineer, Lockheed Aircraft Corp., Burbank, Calif.; **ROBERT FRANZ KOHR,** executive engineer, Ford Motor Co., Dearborn, Mich.; **JOHN LANSFORD McCLOUD,** manager, manufacturing research, Ford Motor Co., Dearborn, Mich.; **CLYDE RAYMOND PATON,** director of engineering, Willys-Overland Motors; **JAMES DEYO REDDING,** executive director, Committee on Aeronautics, Research and Development Board, Dept. of Defense, Washington, D. C.; **MAX MOSS ROENSCH,** research supervisor, Ethyl Corp., Detroit; **ELBERT SANDS ROWLAND,** chief metallurgical engineer, Timken Roller Bearing Co., Canton, Ohio; **RONALD BROMLEY SMITH,** vice-president in charge of engineering, M. W. Kellogg Co., N. Y.; **EDWARD ARCHIBALD STALKER,** president and general manager, Stalker Development Co., Bay City, Mich.; **MILTON JOHN THOMPSON,** professor and chairman, Dept. of Aeronautical Engineering, associate director, Defense Research Laboratory, University of Texas, Austin; **SAM TOUR,** president, Sam Tour & Co., N. Y.; **GEORGE BENSON WATKINS,** director of Research, Libbey-Owens-Ford Glass Co., Toledo; **THOMAS HOWARD WICKENDEN,** vice-president and manager, Development and Research Division, International Nickel Co., Inc., N. Y.; **GRANT SMITH WILCOX, JR.,** coordinator of special program development for Plymouth Division, Chrysler Corp., Detroit; **ROBERT JAMES WOODS,** airplane design consultant, Bell Aircraft Corp., Buffalo; **JAMES CHURCHILL ZEDER,** vice-president and director of engineering and research, Chrysler Corp., Detroit, past SAE president, past chairman SAE War Engineering Board; **FRANZ PERRINE ZIMMERLI,** chief engineer, Barnes Gibson Raymond Division, Associated Spring Corp., Plymouth, Mich.

CLARENCE J. WILLIS, formerly assistant to the executive engineer, International Plainfield Motor Co., is now a project engineer with Hyatt Bearings Division, GMC, Harrison, N. J.

RICHARD A. PEENE has accepted employment with the Sikorsky Aircraft Co., Bridgeport, Conn. He was previously a mechanical engineer for the Texas Co.

WEBSTER C. McDONALD, JR. is now a truck planning analyst for the Ford Division of Ford Motor Co., Dearborn. He was previously associated with the Chrysler Corp. of Highland Park, as a junior staff engineer.

ANDREW WESSEL is now a student at the Harvard Graduate School of Business Administration in Boston. Wessel was previously mechanical engineer for the Briggs & Stratton Corp., Milwaukee.

GEORGE J. REED has joined the Fisher Body Division, GMC, Grand Rapids, Mich., as a process engineer. He was previously associated with the ACF Brill Motors Co., Philadelphia, where he was production supervisor.

CHARLES W. VAN OVERBEKE has joined the American Bosch Corp. as field engineer in the Chicago branch office. He was formerly project engineer for the Oliver Corp., Charles City, Iowa.

R. C. WILLIAMS is chief special assignment engineer with the Electro-Motive Division of GMC, Cleveland. He was chief special assignment enginer for GMC's Truck & Coach Division, Pontiac, Mich.

EVERETT G. FAHLMAN, president of The Permold Co., Medina, Ohio, has been appointed deputy director of the Aluminum Division. He is on loan to the Government by his company under a rotation system by which the services of industries' experienced personnel are made available.

JOHN E. FAHLMAN has been appointed acting general manager of The Permold Co. and will assume this extra duty in conjunction with his responsibilities as director of procurement and assistant secretary.

S. S. MEADOWS has been appointed vice-president and manager of the new transmission department of the Marvel-Schebler Products Division, Borg-Warner Corp., Decatur, Ill. He was formerly works manager of the Detroit Transmission Division of GMC.

W. A. ROBERTS, president of Allis-Chalmers Mfg. Co., Milwaukee, has announced that his firm has officially

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Obituaries

ARTHUR R. BLOOD

Arthur R. Blood, engineer in the Tractor Division of Allis-Chalmers Mfg. Co., Milwaukee, died October 1 from a heart attack. He was 62.

Blood spent most of his engineering life in engine design work. For the last 18 years he worked on engine design at Allis-Chalmers.

Previously he had been with Lycoming Motors, and before that with H. H. Franklin Mfg. Co., makers of Franklin automobiles.

He was born in Warren, Pa., and was a graudate of Cornell University's school of engineering. He was also a member of Tau Beta Pi, honorary engineering fraternity.

Surviving are his wife, Alison; his son, William R.; three daughters, Mrs. Louis Dymond, Mrs. Robert Allen, and Mrs. Ray Vyvyan; and a sister, Mrs. Bernard Leslie.

BYRON S. SNOWDEN

Byron S. Snowden, transportation manager of General Ice Cream Corp., Schenectady, New York, died August 11. He was 61.

Snowden was transportation manager for General Ice Cream Corp. for 25 years and in this capacity was in charge of the company's truck fleet, garages, and passenger cars. He was also in charge of the design of truck bodies for transporting ice cream.

He was a member of SAE for thirteen years.

DWIGHT R. JUDSON

Dwight R. Judson, owner of the Dwight R. Judson Co., Hartford, Conn., died suddenly September 26. He was 74.

Judson served on the Board of Governors of SAE's New England Section and at one time (1937) was honored by the Society as a pioneer of the auto industry. He was interested in automobile lubrication.

He was a Spanish American War veteran, having served as a hospital steward with the Naval Battalion of the Connecticut National Guard.

Though a native of Fairfield, Iowa, Judson was educated in the schools of East Hartford. In 1896 he entered the drug business with the Goodwin Drug Co. and became a licensed druggist in 1900.

Later he joined the Sisson Drug Co. and was with that firm until World War I. Then he organized the Dwight R. Judson Co., distributors of paints, chemicals, and lubricants.

Judson was a prominent Mason. He received honorary memberships in the Moolah Shrine Temple in St. Louis, Mo., and Melha Temple, Springfield, Mass., for his interest in the Shrine Hospital for Crippled Children.

Survivors are: his wife, Mrs. Margaret Grozier Judson; a stepdaughter, Mrs. Virginia Coracci; a sister, Miss Helen Judson; and two grandchildren.

THOMAS STEWART BLAIR

Thomas Stewart Blair, 55, manager of aviation sales and engineering, Petroleum Advisers, Inc. (Cities Service Oil Co.) was killed in an airplane crash October 28. Blair was alone in the plane when the accident occurred near Bunnell, Florida.

He had been manager of aviation sales and engineering for Cities Service since 1938. Previously he had been a power prover engineer in the Marketing & Refining Division, and prior to that a research and test engineer for the company.

Blair was a civilian pilot and engineer in both the U. S. and England. During World War I he served as a lieutenant with the Royal Field Artillery and the Royal Air Force.

His education was received in England. He was graduated from Dulwich College, London, and obtained his M. E. degree from the Imperial College of Science and Technology, London.

He was a member of many organizations, including the American Petroleum Institute, the Aircraft Owners and Pilots Association, National Aeronautical Association, Quiet Birdmen, Aviators Post No. 743, American Legion, the United Services Club and the Kameron Game (Quebec), as well as SAE.

He is survived by his widow, the former Winifred J. R. Adams, a daughter, Joan-Roy, and a sister, Mrs. M. B. MacDonald.

EDWIN H. HORNE

Edwin H. Horne, 52, manager of the automotive sales department, National Refining Co., Cleveland, died September 22.

Horne joined the National Refining Co. in 1924 where he supervised technical sales. In 1944 he left to join Fleet-Wing, Inc., but returned to National Refining two years later.

SAE Student News

Parks College

WILLIAM F. CARROZA (center), student at Parks College, St. Louis University, receives the school's student award for 1953. Carroza is a past-chairman of the Student Branch.

FORMER DEAN NIELS C. BECK (left) presents the award. Beck is now with the Armour Research Foundation (see page 80, November SAE Journal) and is past-chairman of the St. Louis Section.

DALE NAUMER (right) waits to present the brief case that accompanies the award. Naumer is also an SAE member and is president of the student council.

California State Polytechnic College

MEL HALL, SAE's student chairman of the Southern California Section, inspects the SAE scrapbook which **STAN ADKINS**, chairman of the Student Branch, holds at a recent student meeting at the California State Polytechnic College.

A strange property of aluminum, Mel Hall said, is the oxide film that forms on the surface upon contact with the atmosphere. This film is stronger than the hardest diamond, but it is so thin that it requires electronic equipment to measure it.

Hall is affiliated with Reynolds Metals in Los Angeles. He is also the Southern California Section's student chairman.

Speaking about the attributes of aluminum, he said it is cheap to produce in pure form, light, polishes with ease, but is weak.

Hall then traced the history and activities of SAE. He said the Society began with 20 members in 1900 and has increased to over 18,000.

Parks College

At the first meeting of the new school year, Edmond Siroky of the Wagner Electric Co., St. Louis, discussed the design of brakes and the mathematics involved.

During the same meeting a membership drive was instituted to enroll engineering students from the freshmen. Twenty-five freshmen were already present—a pretty good start!

Detroit Institute of Technology

"To be an engineer is the highest mark of service." That's what Ernest Lamb told student members at their first luncheon meeting. Lamb is chief engineer of the Truck Division, Chrysler Corp.

He said the goal of present day engineers is to strive for progress and improve the world. He also stressed that the SAE is an important organization and that it offers unlimited opportunities to the engineering student.

Lamb warned the members not to become dissatisfied or disappointed with their first job. The first and second years are "soaking years." These are important for well rounded training.

The new student officers are: Stanley Sonk, president; Jack Parker, vice-president; James Cahill, secretary and treasurer.

Missouri School Of Mines and Metallurgy

The Missouri School of Mines and Metallurgy in Rolla, Mo., has received its charter establishing a student branch—after much hard work and patience.

The idea of a student branch was first thought of two years ago. A group of students was organized to meet under the title of "The SAE Club." In May, 1952, the first meeting was held. Membership advanced to such a point that the club was ranking in the upper brackets of regular student branch enrollment.

Last spring a petition was sent in to national headquarters. The result? A charter this fall! Charles Remington of the mechanical engineering department, one of the pioneers of the organization, was appointed the first advisor.

Already this fall the branch has begun an ambitious schedule. During the annual parents and engineers day, the school's laboratories were turned over to the branch and students explained equipment to visitors.

from the Sections

Racing in Europe, in the States, and "South of the Border" has proved a popular subject throughout the Sections. In Detroit, Z. Arkus-Duntov described the Le Mans Race as "a powerful advertising medium" for European automobile manufacturers. The development of the racing car and its contributions to passenger autos both in the U. S. and in Europe were subjects of R. T. Jackson's talks at the Central Illinois and Milwaukee Sections. And, because of the growing interest in the Pan-American Road Race, SAE's Southern California Section had participants "down Mexico way" as guest speakers.

South Texas Division of Texas

Field Editor
L. L. Phillips

Sept. 28—Members were literally "taken for a cleaning" at this meeting. As guests of the San Antonio Transit Co., they took a bus ride through the automatic washing machine in the maintenance department. Then they saw a mammoth vacuum cleaner **displace 20,000 cu ft of air per min.** during the cleaning of the bus. These were just some samples of the **modern equipment** used by the company.

K. M. Kendall, superintednent of equipment, said the transit system has low-cost operation as compared with other companies. Approximately $100,000 per month is used in the **maintenance budget,** but he cited figures to show this is below the industrial average in maintenance cost per mi.

This is true because the shop has modern equipment and the **company uses propane** for the principal fuel.

The transit company has set up a rigid inspection system calling for certain inspection operations each 1500 miles of a 48,000 mile cycle.

Work becomes **progressively heavier** throughout the cycle. For example, the 1500 mile inspection calls for 16 inspection operations. The 48,000 mile inspection requires 16.3 man hours for just the inspection work. Repair work would take additional time.

Detroit

Field Editor
W. F. Sherman

Oct. 5—Maurice Olley indicated some discontentment with **today's sports cars.** Olley was once the designer for Sir Henry Royce. Now he's director of research and development for Chevrolet.

Reviewing the characteristics of **15 different sports cars,** he pointed out that the range of characteristics is great. Weights run from 1700 to 3600 lb, engine size from 75 to 250 cu in., and maximum hp from 50 to 175.

He said that though there isn't any strict **definition of a sports car,** there are some criteria. He said piston speed should be less than 2500 fpm at 70 mph, power-weight ratio should be better than 25 lb per hp, and there should be ample brakes. Olley said other desirable qualities, such as quick steering with light handling, immediate steering response without oversteer, should

San Diego (Sept. 28)

On The West Coast, before leaving for Hawaii, President Robert Cass (extreme left) stopped off to chat with San Diego Section members.

From Section Cameras

Rochester Division of Buffalo (Oct. 8)

Dining By Candlelight are: (l. to r.) H. Dietrich, chairman of Meetings & Arrangements, Rochester Division; E. Olson, chairman of the Program Committee, Rochester Division; W. M. Bradley, assistant works manager, A. O. Smith Corp., Rochester; A. J. Ristow, works manager, A. O. Smith; H. N. Clark, vice-chairman, Rochester Division; E. W. Chapman, chairman, Buffalo Section; C. L. Nelson, secretary-treasurer, Buffalo Section; and E. F. DeTiere, secretary-treasurer, Rochester Division.

Wearing Protective Glasses, members of the Buffalo Section tour the A. O. Smith plant in Rochester, N. Y. The tour was arranged and prepared by H. Vickerman and E. F. DeTiere of the Section's Rochester Division.

be characteristics too. Chevrolet's Corvette meets all these requirements.

. . . Racing is **a powerful advertising medium** for automobile manufacturers throughout Europe. Z. Arkus-Duntov, who was also at this meeting, said four million spectators witness the race directly and it is difficult to assess the number reached by radio and press.

"The very entrance of a manufacturer's car in the Le Mans Race is a demonstration that the automobile, if it sells on virtues other than sheer performance, has creditable speed and stamina.

"Winners' gains which can be converted into publicity and eventual sales for manufacturers are: victory through distance, victory through efficiency formula, and victory within a class.

"Manufacturers enter the races for the **promotion advantages** involved, but in addition, their wealth of technical knowledge is invariably increased.

"For the engineers, entering the races poses challenging problems which must be conquered, and conquest of the problems is the very **essence of engineering.** The conquest makes engineering at once the hardest and most gratifying profession there is."

Assistant Field Editor
D. T. Roberts

Oct. 19—With **the woman driver** or the physically handicapped person, power steering can mean the difference between driving and not driving. It can mean the difference between driving for pleasure and just plain drudgery. **Faster response,** greater safety in dangerous situations, and assistance in parking, were even further advantages brought out by Dennis Hayman of Gemmer Mfg. at Detroit's Junior Activity Meeting. Hayman was one of three panel members who presented a program, "Power Takes Over the Wheels." The other two were Joe Farnham of Chrysler and Ford's Dave Kozier.

He said power steering on present day trucks can mean **increased payload** since more weight can be carried on the front end. One **drawback to volume production,** however, is the wide variety of trucks. This makes interchangeability difficult.

Joe Farnham thought power steering should conform to the familiar "feel" of a standard steering installation. He said the driver should not be conscious that he's being assisted. **A certain amount of steering effort** should be retained.

Dave Kozier said that in testing there was a **need for more information** and special equipment. He mentioned as examples, the **torquemeter**—to measure steering wheel effort, and the slide wire **pontentiometer**—to measure car wheel and steering wheel angles.

In his opinion, **recovery characteristics** could be better. Some drivers have complained of feeling **a lack of control.** Perhaps these drivers aren't used to power steering. On the other hand, maybe we can make power steering easier to become used to.

Field Editor
W. F. Sherman

Oct. 26—In 1923 "Ike" Eisenhower, then a lieutenant colonel, led a convoy of military vehicles across the continent. He was ably assisted by Captain Arthur Herrington (a past-president of SAE and one of the founders of Marmon-Herrington Co. in Indianapolis).

This incident was just one link in the chain of actions that brought about **standardized military trucks.** H. D. Duppstadt mentioned this event while tracing the history of these trucks.

Even before President Wilson authorized $175,000 (July 1917) for the project, the **SAE and industry had loaned engineers** to organize basic work. Two months after Wilson's action, pilot models were being exhibited in Washington.

. . . Speaking about the **mobility of modern warfare,** Duppstadt related a story of "a high ranking German Officer" of World War II. The officer admitted one of the items his staff neglected to consider was that every American truck would have **all-wheel drive.**

Rochester Division of Buffalo

Field Editor
E. F. DeTiere

Oct. 8—One-hundred members and guests were on hand for a tour through the Rochester Works of A. O. Smith Corp., manufacturers of **automotive pressed steel parts.**

After members saw the **contour rolling of steel,** marquench tempering, and the welding of precision aircraft parts, A. J. Ristown, works manager, gave a welcoming talk. A short film showing the plant and products of the company followed. Then assistant works manager, Wililam Bradley, gave a brief description of the process used in welding alloy steel airframe components for the B-52.

The tour, which was sponsored by the Rochester Division of Buffalo Section, included both Rochester and Buffalo members.

Texas Gulf Coast

Field Editor
W. B. Tilden

Oct. 9—With few exceptions, **engineering education has** not made many changes in the past 25 years, according to H. W. Barlow, Dean of Engineering at Texas A & M College. He said changes in engineering education must be made so today's engineers will be able to handle the more complex problems 25 years hence.

He suggested that more "why" be added to the engineering curricula and less "how." Theoretical considerations and **new scientific developments** in such fields as electronics and nucleonics make it imperative that old and useless material in our curricula be discarded. We must search for better ways to **teach engineering** students more of the fundamentals than we have in the past, Barlow said.

The trend is toward more science, less duplication, higher standards, less skill courses and the attempt to develop **a professional attitude** in the early years of the young engineer's training, he said.

SAE President Visits Hawaii

President and Mrs. Robert Cass

Hawaii

President Robert Cass returned late in October from a visit to SAE's Hawaii Section. While there, he spoke at a meeting of the Section at Honolulu and of the Section's Island of Hawaii Group at Hilo. Accompanying him on the trip were Mrs. Cass, SAE Secretary and General Manager John A. C. Warner and Mrs. Warner, and SAE Past-President Ralph R. Teetor and Mrs. Teetor.

President Cass and his party received lavish Hawaiian welcomes and generous hospitality during their 12-day visit. "They managed to combine 'aloha' with the business of attending meetings," reports SAE Journal's Hawaii Section field editor, Richard D. Deemer.

Leading the hospitality legions were

Prominent at the Hawaiian Section meeting where President Cass spoke were: (left to right) John A. C. Warner, SAE Secretary and General Manager; SAE Past President Ralph Teetor; T. F. Cowley, chairman of the Section's Arrangements Committee; K. M. Watson, Section Secretary; Fred Hedemann, Section Chairman; President Cass; George Wheelright, chairman of the Section's Program Committee; and Robert L. Muller, (foreground) chairman of the Section's Placement Committee.

Hawaii Section Chairman Fred Hedemann at Honolulu, and Vice-Chairman William R. Chillingworth at Hilo.

Journeying partly by boat and partly by air, members of the Presidential Party were regaled with orchid-bedecked welcomes, complete with band and hula troupes at Honolulu, and with an official "key-to-the-city" reception to Mr. Cass at the airport at Hilo.

Messrs. Hedemann and Chillingworth presided respectively at the Honolulu and Hilo meetings. Governing Board members and past officers of the Section and Group, with their ladies, shared the honors at social functions tendered at both ports of call.

Cass brought to the Hawaii Section meetings in Honolulu and Hilo the story of specific frontiers which stand as a challenge to the engineer of today. Emphasizing the importance of materials problems, and their engineering implications, Cass stated that scarcity of copper is strongly influencing design, whereas nickel is currently the most critical of alloy materials. It bids fair to remain so, he observed.

President Cass urged engineers to better acquaint themselves with management matters and suggested that consideration be given to producing lower priced passenger cars that can operate at half the cost-per-mile of existing models. Engine design, he indicated, would be an important factor in development of any such trend.

Teetor voiced the Presidential Party's sincere appreciation for the Section's friendliness and generous hospitality. He commended the members for their progressive resourcefulness in automotive transportation fields. He recounted benefits that have come to him during more than 40 years of continuous membership in SAE.

Warner showed a motion picture film of SAE Council members, each pictured in his own engineering environment. The film, he said was developed to better acquaint SAE Section members with the officers of the Society.

Southern New England

Field Editor
A. D. Nichols

Oct. 6—**Traffic moves slower** than it did 50 years ago. That's what Glen B. Eastburn told Southern New England members. Eastburn is assistant to the president of New York Airways.

He said a truck takes at least 1½ hours to go from Newark Airport to Idlewild—if all the conditions are favorable. The helicopter travels the same distance in twenty minutes.

He believes the New York metropolitan area is a "natural" for the 'copter.

By the way, last July **passenger service was certified** for New York Airways by the CAA. It's the only company to hold this certificate.

Dayton

Field Editor
P. J. Long

Oct. 15—The necessity of **accurate testing and evaluating** various parts of the automobile was stressed by L. C. Lundstrom at this meeting. Lundstrom is assistant director of General Motors proving grounds.

The **merits and methods of testing** were covered and Lundstrom described the General Motors proving grounds in Milford, Mich., and Phoenix, Ariz. Slides and films were used to supplement the talk.

Milwaukee

Field Editor
D. Roger Neeld

Oct. 2—The best thing American designers could **borrow from racing cars** is less weight. It would help give increased operating economy and **better performance.** R. T. Jackson pointed this out to the Milwaukee Section. Jackson is a sales engineer for Perfect Circle. Designers realize the **possibilities of lighter cars,** but customers want heavier autos.

In America, important tire developments have been the only contributions racing has given passenger cars. In Europe, racers are the prototype of passenger autos.

Central Illinois

Field Editor
W. J. Lux

Sept. 28—Speaking about **the design of race-cars,** R. T. Jackson said some items are borrowed from passenger cars. Others are taken from **midget autos.** Jackson is a sales engineer with the Perfect Circle Corp.

Typical of racing car development to date, are carefully designed details such as constructions of the frame and body, front and rear suspensions, fuel tank mounting and quick-change rear axles. Each feature is chosen for some particular merit.

The quick-change rear axle is a straight solid axle with a simple spur gear unit. This **unit can be changed easily** to give the **proper drive ratio** for the best performance under conditions dictated by the track and race.

He said the "wagon axle" suspension is considered better for dirt track racing than independent suspension.

In discussing the models run in the Indianapolis Race this year, Jackson said Kurtis-Kraft cars with **Offenhauser engines were dominant** as they've been in the past.

Oct. 19—With more complex construction machinery and **higher operating costs,** preventive maintenance is important. That sums up Fred S. Wimberly's talk to

From Section Cameras

Central Illinois (Sept. 28)

Robert T. Jackson acts as narrator while Section members watch movies of the '53 Indianapolis Race.

St. Louis (Oct. 13)

Behind The Piggy bank are: (l. to r.) Harold C. Glidewell, secretary; Ralph Russell, student branch chairman at Parks College (presenting gavel); Chairman M. C. Alves; and speaker Herman L. Hartzell. (The pig, its contents, and blanket will be a door prize at the last meeting of the season.)

Southern California (Oct. 15)

In The Line-Up are: J. O. Findeisen (extreme right), chairman, and Judd Pickup (fourth from right), vice-chairman of the Section's Passenger Car Activity. They met with participants in the Pan-American Stock Car Race. This race was the subject of the Section's October meeting. Left to right: mechanic and co-pilot last November, Rocky Iglesias; third place winner in '52, Walt Faulkner; sponsor of the second place car in '52, Bob Estes; first place winner in '52, Chuck Stevenson; mechanic and co-pilot in '52, Chuck Daigh; Judd Pickup; driver of his own car in '52, Ray Crawford; ace mechanic at many Pan-American races, Clay Smith; and J. O. Findeisen.

the Central Illinois Section. Wimberly is supervisor of Allis-Chalmers' Industrial Sales and Service School.

It's **no longer sufficient** to fix or replace broken and worn-out parts, he said. There must be **a systematic program** to prolong machine life and reduce time for repairs.

A movie showing the **preventive maintenance program** used on the Garrison Dam Project illustrated his talk. At this project, a master record is kept on all machinery, and there are **periodic inspections and** adjustments.

John W. Hobbs was given a plaque recognizing 35 years of service as an SAE Member.

Mohawk-Hudson

Field Editor
Lewis F. Smith

Oct. 13—Five or six years from now **little development work** is going to be done **on reciprocating engines,** as far as new airplanes are concerned, W. R. Eichberg told Section members. He said **turbojet** and **turboprop** engines will be planned for all new installations.

Eichberg is manager of the Reciprocating Engine Division, Curtiss-Wright Corp. He's now preparing a formal paper on the **development of the turbo-compound** engine for the Annual Meeting in Detroit next January. F. J. Wiegand, development diector, rotating engines, at Curtiss-Wright Corp. is co-author.

Eichberg used slides to demonstrate how the three-geared exhaust turbines **increased the 2750 hp** output of an R3350-26W basic engine to 3250 hp. Also, high-power cruise specific fuel consumption was reduced to 0.405 lb per bhp-hr, and at a lower rating to 0.385 lb per bhp-hr.

St. Louis

Field Editor
A. W. Zub

Oct. 13—Four basic needs—better ignition, generator and cranking motor performance, and improved electrical distribution would be amply supplied by **a 12 volt system.** This was pointed out by H. L. Hartzell of the Delco-Remy Division, GMC. Hartzell was presenting his sequel to "The 12 Volt Story," titled, "It's Still 12 Volts."

A steady **rising demand for electrical power** since 1934 has finally approached the 400 to 500 watt range—where **it is economical** to change to 12 volts. **Thirty per cent more output** can be obtained.

The six volt system has presented cost and installation problems. With lower currents of the 12 volt system, **wire sizes can be reduced** four to six gages. This makes the smaller cables **easier to handle** and fabricate.

. . . Something new was added at this meeting—a large piggy bank. Members were invited to drop their pennies in it and at the last meeting of the season, the bank will be a door prize.

New England

Field Editor
E. F. Donahue

Oct. 8—One of the biggest problems in the **'53 air-conditioned Oldsmobile** was keeping the weight down. But, E. M. Estes is convinced air conditioned autos are here to stay. Estes is a chassis engineer in the GMC Oldsmobile Division.

In the '53 Olds, there was **a vehicle weight increase** of 255 lb, 143 lb on the front wheels, and 112 on the rear ones. He said other problems were: not allowing the air conditioning to overload the engine cooling system, and keeping vibration and noise to a minimum.

Lucille Pieti, who was in Boston with the "New Worlds in Motion" show, stopped in at the meeting. She's a member of the Detroit Section and has received a great deal of publicity as **Chrysler's first woman engineer.**

Pittsburgh

Field Editor
O. B. Rosstead, Jr.

Oct. 27—The **danger to the motorist** who mixes different brands of lubricating oil is practically non-existent. That was the opinion of Dr. L. C. Beard, Jr., assistant director of Socony Vacuum and president of ASTM. Beard spoke at a joint meeting of the SAE Pittsburgh Section and ASTM's Pittsburgh District.

His paper covered **30 years progress** in the improvement of fuels and lubricants by the use of additives. He said additive sales now gross $400,000,000 a year. Tetraethyl lead, the **best known of the additives,** can give us a gasoline 50% better than we had 25 years ago, yet costing no more.

Kansas City

Field Editor
Samuel Melo

Oct. 1—A manager must be **politically minded** to reach the highest levels, C. W. Frederick told Kansas City Section members. Frederick was presenting his paper, "What the Engineering Management Requires of the Engineer." But, he continued, not so political that to further his own interests, he destroys **group teamwork.**

Frederick is assistant chief engineer of the Chevrolet Division, GMC. He has had 30 years experience—starting as an apprentice engineer and climbing to top manager.

He warned potential managers to be wary of majority decisions. Lots of people want to be **on the side of the heavy battalions,** he said. Usually those in a minority group expect opposition and their reasoning is more explored. He said it's in this group you find the most honest workers, but don't confuse them with **reactionaries.**

It was Frederick's opinion that few good ideas ever

come to most of us. So, we must make good use of our own and be ready to accept those of fellow workers.

Most **engineers in the future** will have a formal education. Their technical training will be good, but he itemized some things it should include: ability to work with others, aggressiveness (tempered with patience), enthusiasm, and power of concentration.

A man should be able to do what he's told gracefully, after he has failed to sell you his way. He should **get along with people** at all levels, and deliver a good day's work for a good day's pay. Furthermore, he should meet his assignments on time.

At the end of the meeting, a movie was shown about Chevrolet's Corvette.

Contrary to common opinion, GM did not intend to develop a radical or extremely **high performing sports car.** It was intended primarily as a showpiece for the GM Motorama. It presented a sports car using, as far as possible, standard Chevrolet components.

Only public demand and requests from dealers moved GM to produce the Corvette commercially.

British Columbia

Oct. 5—**A man's work habits** are an indication of his potential abilities. "Notice his workbench, the condition of his personal tools, and the care he takes of the company tools."

These suggestions came from Leo Schamadan as a sidelight to his paper, "The Cost of Adequate Bearing Maintenance." Schamadan is a field engineer with the Cleveland Graphite Bronze Co.

It's a good idea to **continue the education** of people engaged in maintenance work. Encourage them to attend technical meetings and provide them with some good technical magazines. The quickest way to **establish pride in a man** is to provide him with enough information so that he'll be considered an expert by his associates.

Williamsport

Field Editor
Paul Cervinsky

Nov. 3—J. E. Glidewell believes LPG has many advantages other fuels don't have. Glidewell is chief engineer with the Hall-Scott Motor Division, ACF-Brill Motors.

If you handle it properly, he said at this meeting, LPG **presents no more problems** than any other fuel.

Among its advantages he listed:

1.—**Engine life** and operation greatly **extended.**
2.—Cleaner oil and internal engine parts with no carbon formations.
3.—**Higher compression ratios** can be used without detrimental effect.
4.—In proper geographical location, it can be purchased more economically, and
5.—**Lower costs** are claimed by most operators.

Southern California

Field Editor
William E. Achor

Oct. 15—Interest in the development of the **Pan American road race** is growing rapidly. Bob Estes (owner of the Lincoln-Mercury agency in Inglewood, Calif.) said this race has shown the **need for better brakes,** shock absorbers, tires, chassis, and general safety features. Highly specialized track racing, as the Indianapolis 500, **no longer offers much design data** to the manufacturer.

Ray Crawford said tires are extremely important in this race. Ray, vice-president of Crawford Stores, was entered in the '52 contest. He said **he wore out 27 tires** during the five day run, covering 2000 mi.

Clay Smith was at the meeting too. Smith was winner of the "Mechanic of the Year" award in 1950 and '52. He talked about rules and their changes over the years.

Metropolitan

Field Editor
Leslie Peat

Oct. 15—In **1961 auto performance** will be 12% better than today's average. This was the prediction of Dr. Eger Murphree, president of the Standard Oil Development Co. In succeeding years, there may be a **25% gain.** Murphree thought this possible because of **new gasoline refining processes** and **improved engine designs.**

He objected to **the Paley Report** of the Material Policy Commission. He said the **Commission was misinformed** in its conclusion that a great deal of energy is lost in producing higher octane gasoline. The efficiency increase of the average car will more than **offset increased energy** used in advanced refining techniques. He pointed out that in the late '30's the development of catalytic cracking caused **a major economy** in the country's oil reserves.

Oct. 21—Thomas B. Rhines believes the turboprop engine has **many possible applications** in the military services for all kinds of operations. He admitted the exception is in interceptor-fighters where speed alone governs the engine requirements. Rhines is assistant chief engineer of Hamilton Standard Division, United Aircraft Corp.

The **extra features of the turboprop** may be of great importance, may be for convenience, or could be somebody's pet idea. Opinion of the proper classification of any given extra feature will be **far from unanimous.**

"Until the turboprop becomes well established in field experience we should demand in its control system the least number of functions that can be accepted by the operating crew.

"Unless the pressure for more and more extra features drives complications beyond reasonable bounds, there is **no reason to shy away from the turboprop** on the grounds that it is too complicated."

New Management for L.A. Production Forum

TAKING over the operation of the 1954 Aircraft Production Forum in Los Angeles are Oliver P. Echols (right), president of Northrop Aircraft, Inc., who is Forum Sponsor, and H. W. Thue (left), plant manager of Douglas Aircraft Co.'s Santa Monica Division, who is General Chairman of the Forum.

NEWS OF SAE

HELICOPTERS . . .

. . . will be subject of full day of Annual Meeting sessions.

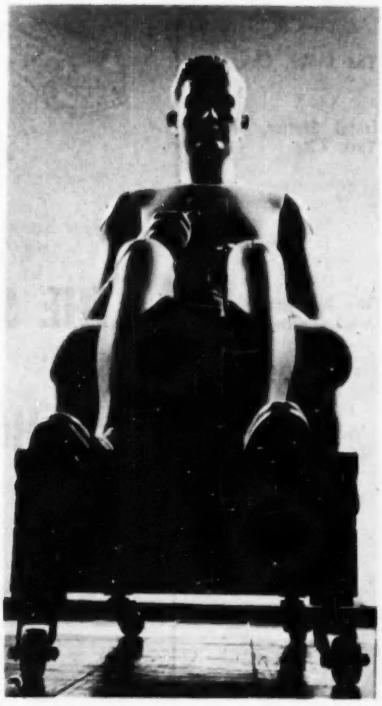
A FULL day of sessions on helicopters is among the three days of Annual Meeting events planned for engineers in the aviation industry.

There will be a two-session symposium on helicopter fatigue problems Thursday morning and afternoon, January 14, and a session devoted to helicopter operations that evening. All three sessions are scheduled for the Hotel Statler in Detroit.

Besides these sessions, there will be five other sessions sponsored by the Aircraft, Aircraft Powerplant, and Air Transport Activities. Details of all sessions are given in the Annual Meeting program appearing on pages 90–95.

Also of interest to engineers in the aviation industry are these events sponsored by other SAE activities: a Monday afternoon symposium on passenger seat design, a Tuesday morning symposium on "Metal Failures as Influenced by Residual Stress, Fretting, and Corrosion," a Tuesday evening session on tool control and plant hazards, three papers on engine combustion theory on Thursday morning, and a paper Friday afternoon on the free-piston and turbine compound engine. These events also appear on the complete program included in this issue.

Meet Oscar . . .



Oscar, the composite of 68,000 men, will put in an appearance at SAE Annual Meeting in Detroit next month. He is used by Ford Motor in its passenger car seating studies and will be demonstrated at a panel session on car comfort and seat design.

Oscar was built from physical dimensions of 68,000 soldiers compiled by the Office of the Surgeon General during World War II. He is 5 ft 10½ in., weighs 155 lb, and is made of plastic. Seats as well as headlinings and windshields have been built around Oscar's dimensions.

The use of Oscar in seat design will be described by E. C. Pickard, of Ford. At the same session, F. C. Matthaei, of American Metal Products, will describe the universal positioning seat. And Prof. Walter Lay, of the University of Michigan, will tell of what happens to a passenger when traveling in a car.

SAE National Meetings . . .

Meeting	Date 1954	Hotel
Annual Meeting and Engineering Display	Jan. 11-15	The Sheraton-Cadillac Hotel and Hotel Statler, Detroit
Passenger Car, Body, and Materials	March 2-4	Hotel Statler, Detroit
Production Meeting and Forum	March 29-31	The Drake, Chicago
Aeronautic Meeting Aeronautic Production Forum, and Aircraft Engineering Display	April 12-15	Hotel Statler, New York City
Summer	June 6-11	The Ambassador, Atlantic City, N. J.
West Coast	Aug. 16-18	Hotel Statler, Los Angeles
Tractor and Production Forum	Sept. 13-16	Hotel Schroeder, Milwaukee

TENTATIVE PROGRAM

ANNUAL MEETING

DETROIT, MICHIGAN

JANUARY 11-15, 1954

THE SHERATON-CADILLAC HOTEL

HOTEL STATLER

and

DETROIT MASONIC TEMPLE

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
29 WEST 39th STREET • NEW YORK 18, N. Y.

Monday, Jan. 11

Grand Ballroom

The Sheraton-Cadillac Hotel

10:00 a.m.

Chairman—N. R. BROWNYER, Timken-Detroit Axle Div., Rockwell Spring and Axle Co.
Secretary—WALTER LOCKE, Timken-Detroit Axle Div., Rockwell Spring and Axle Co.

Drive Line Units for High-Speed Truck Engines
W. P. MICHELL, Spicer Mfg. Div., Dana Corp.
There are eight-cylinder high-speed engines in the future of the freight-hauling truck, and profound effects upon driving units. Watch the gear ratios and hear, by recordings, the cab noises.
(Sponsored by Truck and Bus Activity)

2:00 p.m.

Chairman—J. R. ALMOND, The Midland Steel Products Co.
Secretary—T. J. DURKIN, The Midland Steel Products Co.

SYMPOSIUM—Heavy-Duty Brake Maintenance and Brake Balancing Procedures

Basic Maintenance Requirements for Brakes for Commercial Vehicles
R. K. SUPER, Timken-Detroit Axle Div., Rockwell Spring and Axle Co.

Brake Maintenance Pays
R. A. GOEPFRICH, Bendix Products Div., Bendix Aviation Corp.

Coordination of Electric with Other Braking Systems
F. C. HILE, Warner Electric Brake and Clutch Co.

Pneumatic Aspects of Brake Balancing—Manufacturer's Viewpoint
STEPHEN JOHNSON, JR., Bendix-Westinghouse Automotive Air Brake Co.

Brake Balancing Procedures—Operator's Viewpoint
R. H. MOORE, Conestoga Transportation Co.

Dollars, service, and safety are the stakes in brake maintenance. This forum, developing both the practical values and the knowhow, compares the costs and perils of brake care vs. neglect.
(Sponsored by Transportation and Maintenance Activity)

Grand Ballroom, Hotel Statler

10:00 a.m.

Chairman—V. A. CROSBY, Climax Molybdenum Co.
Secretary—JAMES MANGANELLO, Chrysler Corp.

Pearlitic Malleable Iron (Its Properties and Expanded Uses)
C. F. JOSEPH, Central Foundry Div., General Motors Corp.
Use of malleable iron castings is growing rapidly. Engineers have found that they give satisfactory performance and, in most instances, a considerable saving over steel forgings, stampings, or weldments.

Measurement and Control of Residual Stresses in Cylinder Block Castings
R. E. VanDEVENTER and FOREST McFARLAND, Packard Motor Car Co.
Modern stress analysis may be used to locate trapped stresses in intricate castings before cracks appear. Here the methodology is outlined.
(Sponsored by Engineering Materials Activity)

2:00 p.m.

Chairman—J. D. CATON, Monroe Auto Equipment Co.
Moderator—HENRY GREBE, Ford Motor Co.
Secretary—E. W. A. LANGE, Ford Motor Co.

PANEL—Passenger Car Comfort and Seat Design

The Use of "Oscar" in Seat Design
E. C. PICKARD, Ford Motor Co.

The Universal Positioning Seat Track
F. C. MATTHAEI, JR., American Metal Products Co.

What Happens To a Passenger When Traveling in a Car
WALTER LAY, University of Michigan

The vagaries of human anatomy, body design, seat dimensions, and the positioning of drivers and riders are being adjusted to the individual rather than the elusive "average." Multi-positioning is the new way to accommodate the long, short, wide, narrow, thick, thin, male, female, and other odd folks.
DEMONSTRATION OF GENERAL MOTORS UNIVERSAL SEAT
(Sponsored by Body Activity)

Evening Session, Grand Ballroom, Hotel Statler

8:00 p.m.

Chairman—K. E. COPPOCK, General Motors Corp.
Secretary—W. K. NORWICK, Fisher Body Division, General Motors Corp.
Business Session of Body Activity

The Corvette Plastic Body
E. J. PREMO, Chevrolet Motor Div., General Motors Corp.
Tracing, by color motion pictures, the transformation of idea into sports car. Includes details of materials testing, tooling, assembling technique, and surface finishing.

Motion Picture—"The Look of Things" (Courtesy of General Motors Corp.)
A fascinating picture story about beauty and how it is instilled into industry's creations. It shows how automobiles, refrigerators, television sets, airplanes and hosts of other products are styled into objects of beauty that match the tempo of our times.
(Sponsored by Body Activity)

SAE members and guests attending the 1954 Annual Meeting are cordially invited to attend the Annual Sports Car and Automotive Style Show to be held at The Henry Ford Museum, Dearborn, Mich. The Show will feature many foreign-made cars and American designs of tomorrow. Emphasis will be placed on new materials, particularly the use of fiber glass and other plastics in bodies. A registration badge for the SAE Annual Meeting will serve as an admission ticket to the Show.

Tuesday, Jan. 12

Grand Ballroom

The Sheraton-Cadillac Hotel

9:30 a.m.

Chairman—H. L. WILLETT, JR., The Willett Co.
Secretary—HENRY JENNINGS, Fleet Owner
Business Session of Transportation and Maintenance Activity

Automotive Engine Head and Gasket Problems
L. E. KASSEBAUM, Consolidated Freightways, Inc.
Here are the reasons why cylinder heads and gaskets on engines used in truck transportation service sometimes fail prematurely.
(Sponsored by Transportation and Maintenance Activity)

2:00 p.m.

Chairman—R. C. WALLACE, Diamond T Motor Car Co.
Secretary—F. B. LAUTZENHISER, International Harvester Co.
Business Session of Truck and Bus Activity

Economic Research in the Truck-Highway Weight Problem
HOY STEVENS, Bureau of Public Roads, U. S. Department of Commerce
All about ongoing studies by National Research Council of the costs of operating trucks, building highways for them, and of how big trucks need be for efficient distribution of necessary commodities.

Comprehensive Load Test Research Critically Needed in the Highway Field
A. E. JOHNSON, Arkansas State Highway Department, and Chairman, Subcommittee for AASHO Load Test Section Project
Describing preparations for load tests to ascertain the effects of vehicle upon roads, actual road needs, and control load-testing for comparing highway designs.
(Sponsored by Truck and Bus Activity)

Continued on next page

Continued from preceding page . . .

8:00 p.m.

ANNUAL BUSINESS SESSION
President ROBERT CASS in the Chair

Nomination and Election of Members-at-large of Annual Nominating Committee
Announcement of Election of Officers for 1954
Presentation of the Annual Report
Presentation of Life Membership

8:15 p.m.

Chairman—M. L. FREY, Allis-Chalmers Manufacturing Co.
Business Session of Production Activity

Statistical Control Methods as Applied to Cutting Tools
W. H. SEACORD and F. L. HELMEL, International Harvester Co.
Perishable tool control programs can be operated with benefits. This paper follows a new tool step-by-step through a complete cycle of the control system.

What Makes a Plant Safe?
W. K. OUSLEY, Boston Manufacturers' Mutual Insurance Co.
Insurance company experience provides data to assist management in planning and evaluating building design. Employee training, protective measures, and recognition of process hazards also help to minimize production interruptions, property losses, and personal injuries.
(Sponsored by Production Activity)

Grand Ballroom, Hotel Statler

9:30 a.m.

Chairman—J. H. DUNN, Aluminum Co. of America
Secretary—J. R. LONG, Aluminum Co. of America
Business Session of Engineering Materials Activity

SYMPOSIUM—Metal Failures as Influenced by Residual Stress, Fretting, and Corrosion

Review of Fretting Corrosion Theory
H. A. PRAY and F. W. FINK, Battelle Memorial Institute
Heavily loaded precision parts fitted with close tolerances are major factors in metal failures from fretting corrosion. The work of many investigators is reviewed in the search for the mechanism.

The Effect of Lubrication on Fretting Corrosion
E. M. JOHNSON, The Texas Co.
Lubricant feedability is a primary factor in mitigating fretting and fretting corrosion. More is there than meets the metal, including oil's consistency, shear stability, bleeding, and additives.

Effects of Residual Stress on Fatigue Life of Metals
R. L. MATTSON, Research Laboratories Div., General Motors Corp.
Experiments with bending fatigue, pitting, spalling, and cold-working reveal the simplicity of making measurements by the dissection method, solve problems of residual stresses and metals fatigue.

Stress Corrosion of 12% Cr Stainless Steel
W. L. BADGER, Thomson Laboratory, General Electric Co.
This technological whodunit trails through accelerated laboratory tests the occurrence, cause, and prevention of stress corrosion cracking in 12% Cr stainless steel compressor blades. Susceptibility of alloy modifications is reported.
(Sponsored by Engineering Materials Activity)

2:00 p.m.

Chairman—C. T. O'HARROW, Allis-Chalmers Mfg. Co.
Secretary—IGOR KAMLUKIN, Allis-Chalmers Mfg. Co.
Business Session of Tractor and Farm Machinery Activity

Friction Facts, Fortes and Foibles
C. S. BATCHELOR and E. L. CAREY, Raybestos-Manhattan, Inc.
Personally-conducted tour of new friction materials, revealing their properties and applications. Meet the new cerametallics, ceramics, and sintered metals, and learn of their possibilities.

Engineering Evaluation of Gear Manufacturing Processes
W. E. GUSTIN and D. C. SMILEY, John Deere Waterloo Tractor Works
Comprehensive discussion of the fatigue and beam strengths and dimensional characteristics of spur gears for tractor transmissions, with emphasis upon laboratory evaluation of service durability.

To be presented by title:
Tractor and Slippage of Caterpillars and Wheels
LIEUTENANT COLONEL M. G. BEKKER, Operations Research Office, The Johns Hopkins University
This paper expounds analytical methods comprising a new tool for ascertaining whether and when wheels or tracks are needed. Factors comprehend soil conditions, traction, flotation.
(Sponsored by Tractor and Farm Machinery Activity)

Wednesday, Jan. 13

Grand Ballroom
The Sheraton-Cadillac Hotel

9:30 a.m.

Chairman—E. N. COLE, Chevrolet Motor Div., General Motors Corp.
Secretary—W. R. MACKENZIE, Chevrolet Motor Div., General Motors Corp.

The New Ford V8 Engine
ROBERT STEVENSON, Ford Motor Co.
Structural rigidity to withstand rising compression ratios, full-flow oil filtration, and integral valve guides are among features of an engine which is fruition of five years of research and development.

What Can We Get From Higher Octane Number Fuels
W. M. HOLADAY, Socony-Vacuum Oil Co., Inc.
Three-D view of the high-octane, high-power, high-cost situation as seen by customers, refiners, and automotive engineers. Plus evaluation of possibilities of getting more miles per barrel of crude oil.
(Sponsored by Passenger Car Activity)

2:00 p.m.

Chairman—P. H. PRETZ, Ford Motor Co.
Secretary—H. M. KING, Ford Motor Co.
Business Session of Passenger Car Activity

Central Power Assist Source
G. W. LEWIS, Electric Auto-Lite Co.
A central source for hydraulic power can serve steering, braking, window lifts, and other units. This arangement is safer, less expensive, and flexible enough to accommodate additional hydraulic-power controls.

EXHIBIT OF HYDRAULIC BRAKE SERVO DEMONSTRATION UNIT

The Chrysler PowerFlite Transmission
A. J. SYROVY and W. R. RODGER, Chrysler Corp.
Word picture of the design and construction of a new, simple, light, smooth torque converter and its hydraulic controls. With special references to the unique one-piece valves for closed-throttle shifting.

EXHIBIT OF CHRYSLER POWERFLITE AUTOMATIC TRANSMISSION
(Sponsored by Passenger Car Activity)

Grand Ballroom, Hotel Statler

9:30 a.m.

Chairman—G. N. COLE, Pratt & Whitney Aircraft
Secretary—R. F. SCHWARZWALDER, Wright Aeronautical Div., Curtiss-Wright Corp.

Development of the Turbo Compound Engine
F. J. WIEGAND and W. R. EICHBERG, Wright Aeronautical Div., Curtiss-Wright Corp.
Introducing the blow-down turbine and expounding compounding as

an energy source. Discussion of basic design, new problems, and other developments.

Simulated Altitude Tests of Large Aircraft Engine Exhaust Systems
C. F. DERBYSHIRE, Rohr Aircraft Corp.
How to ascertain economically at sea level the efficacy of exhaust systems under conditions of gas flow, temperature, pressure differential, and vibration met at altitude.

To be presented by title:
Stresses and Deflections in Planetary Ring Gears
JOSEPH MARIN and R. H. SHENK,
The Pennsylvania State College
The more flexible the ring gear, the more uniform the load distribution among the plant gears and the more power the unit can handle. Here's a method of determining the most flexible ring gear that will have adequate strength.
(Sponsored by Aircraft Powerplant Activity)

2:00 p.m.

Chairman—F. C. MOCK, Bendix Aviation Corp.
Secretary—S. B. SMITH, Bendix Aviation Corp.
Business Session of Aircraft Powerplant Activity

Design Problems of Turbojets for Supersonic Flight
J. S. ALFORD and E. L. AUYER, Aircraft Gas Turbine Div., General Electric Co.
Problems that must be solved in supersonic flight include operating range of the compressor, cycle thermal efficiency, inlet-engine airflow match, jet nozzle problems, and bearing and lube problems.

A Pilot's Viewpoint of Turbojet Control Requirements
R. E. LaCROIX, Aviation Gas Turbine Div., Westinghouse Electric Corp.
The pilot, as the chap who combats a plane's control complications, is in a good spot to compare present independent emergency control provisions with a basically reliable system. This paper tells how flight operations affect pilots fenced-in by controls.

Practical Problems of Turboprop Controls
D. J. NOLAN, Allison Division, General Motors Corp.
(Sponsored by Aircraft Powerplant Activity)

Dinner

WEDNESDAY JANUARY 13

Detroit Masonic Temple
500 Temple Street

6:30 P.M.—DINNER
Fountain, Crystal, and Panel Rooms

8:15 P.M.—SPEAKING PROGRAM
Large Auditorium

K. E. COPPOCK, Chairman, SAE Detroit Section

Presentation of HENRY FORD MEMORIAL AWARD
(Sponsored by SAE Detroit Section)

LOUIS B. NEUMILLER, Master of Ceremonies
President, Caterpillar Tractor Company

ROBERT CASS, 1953 SAE President

WILLIAM LITTLEWOOD,
1954 SAE President-Elect

"Alexander Botts"

William Hazlett Upson

Noted writer and humorist (author of the "Earthworm Tractor" stories made famous in the Saturday Evening Post)

Thursday, Jan. 14

Grand Ballroom, Sheraton-Cadillac

9:30 a.m.

Chairman—F. A. SUESS, Continental Oil Co.
Secretary—E. W. CAVE, Continental Oil Co.

Comparison of Intermediate-Combustion Products Formed in an Engine With and Without Ignition
W. C. DAVIS, M. L. SMITH, E. W. MALMBERG, and JANE ANN BOBBITT, The Ohio State University
Research reveals the reaction products of a motored engine to be essentially those formed in unburned gases of spark-ignited mixtures. Informative substantiation of the motored engine for research in combustion studies.

The Evaluation of the Energy Released During Preflame Reactions
D. R. OLSON, Yale University, J. T. WENTWORTH, and W. A. DANIEL, Research Laboratories Div., General Motors Corp.
A new method for evaluating energy release by examining preflame reactions in engines. Liberation rate is a significant variable, but correlates with radiation intensity.

Combustion Chamber Deposits and Engine Octane Number Requirement
JOEL WARREN, Ethyl Corp.
Continuing studies suggest that knocking harm caused by engine deposits results from a combination of deposit volume and thermal effects, with the heat-capacity more influential than the thermal-insulating effect.
(Sponsored by Fuels and Lubricants Activity)

2:00 p.m.

Chairman—KENNETH BOLDT, Pure Oil Co.
Secretary—GILBERT WAY, Ethyl Corp.
Business Session of Fuels and Lubricants Activity

The Effect of Lubricant Composition on Combustion Chamber Deposits
J. G. McNAB, L. E. MOODY, and N. V. HAKALA, Esso Laboratories, Standard Oil Development Co.
Combustion chamber deposits and fuel octane requirements can be reduced by proper formulation of lubricants. Base stock, volatility, additive type, and content shape the satisfactory blend.

Crankcase Oil—An Approach to the Combustion Chamber Deposit Problem
R. L. OVERCASH, W. HART, and D. J. McCLURE, Kendall Refining Co.
High-compression engines operate satisfactorily on available fuels when using properly-compounded crankcase oil. Field test data confirm laboratory findings that selected oils and additives reduce deposit formation.

Some Effects of Motor Oils and Additives on Engine Fuel Consumption
C. W. GEORGI, Quaker State Oil Refining Corp.
Oil's viscosity alone significantly affects engine power, friction, and

fuel economy. The catch, however, is differentiating between "engine" and "laboratory" viscosities.
(Sponsored by Fuels and Lubricants Activity)

Grand Ballroom, Statler

9:30 a.m.

Chairman—G. A. PAGE, Aeronca Mfg. Corp.
Secretary—H. A. HELSTROM, Chance Vought Aircraft Div., United Aircraft Corp.

Light Aircraft Turbo-Propeller Installations
J. H. GERTEIS, Cessna Aircraft Co.
Experimental installations of small turbine powerplants in Army L-19 aircraft show promising results. This paper treats of control, fuel consumption, altitude performance, and related problems.

Production Application of Structural Adhesive Bonding
G. E. HOLBACK and J. BURRIDGE, Glenn L. Martin Co.
Technical details, slides, movies, and models describe production-scale applications of FM-45 and FM-47 adhesives to major airframe components as primary fastening.
(Sponsored by Aircraft Activity)

2:00 p.m.

Chairman—J. G. WOOD, New York Air Brake Co.
Secretary—ADAM HETZER, Republic Aviation Corp.
Business Session of Aircraft Activity
AIRCRAFT TOOLING

Tooling and Planning Problems Related to Modern Transport Aircraft
J. R. FRANKS and C. S. GLASGOW, Douglas Aircraft Co., Inc.
New transport aircraft designs demand new tools and create new tooling problems. Here's an exposition of tooling techniques for DC-7 titanium nacelles and of the use of optical tooling methods on fuselage jig construction.

Over-all Problems of Producibility
HAROLD HARRISON, Lockheed Aircraft Corp.
No matter what the product, there are certain qualities the producer must develop if his organization is to produce efficiently. These qualities can be defined, developed, and measured.

Automotive Experience with Aircraft Tooling and Manufacturing
JACK SLEAN, Heidrich Tool and Die Corp.
Despite differences in engineering and design procedure, automotive high-production and aircraft low-production tooling have similarities, can exchange techniques and applications. Wing tooling work on the B-47 is illustrative.
(Sponsored by Aircraft Activity)

Michigan Room, Statler

SYMPOSIUM—HELICOPTER FATIGUE PROBLEMS
(Jointly sponsored by SAE Aircraft Activity and American Helicopter Society)

9:00 a.m.

Chairman—R. A. YOUNG, Hiller Helicopters, Inc.
Secretary—D. C. LAUVER, Bureau of Aeronautics

Secondary Fatigue Loading on Helicopters
HARRY TOBEY, Piasecki Helicopter Corp.

Fatigue Failure Observations for Hiller Model 360 Helicopters
R. CARLSON, Hiller Helicopters, Inc.

The Problem of Relating Accumulated Service Fatigue Damage to Remaining Life
H. T. JENSEN, Sikorsky Aircraft Div., United Aircraft Corp.

Fatigue-Proofing Helicopter Components
R. F. BREYER, Bell Aircraft Corp.
Current major engineering job is prolonging the fatigue life of helicopter components.. Design helps; so does materials selection. This symposium develops numerous techniques for extending operating life.

2:00 p.m.

Chairman—BARTRAM KELLEY, Bell Aircraft Corp.

PANEL: FATIGUE RESEARCH APPLICABLE TO HELICOPTERS
Present and Future Research in Government and Private Laboratories
Panel Members:
PAUL KUHN, National Advisory Committee for Aeronautics;
P. A. SIMMONS, JR., Propeller Laboratory, Wright Air Development Center;
SAM GORDON, Battelle Memorial Institute.

Evening Session, Grand Ballroom, Hotel Statler

8:00 p.m.

Chairman—R. J. WOODS, Bell Aircraft Co.
Secretary—R. A. WOLF, Cornell Aeronautical Laboratory
Business Session of Air Transport Activity

An Airline View of the Helicopter
W. L. McMILLEN, American Airlines, Inc.
Exploration of the posibilities of airlines operation of helicopters in the short-haul field. Pertinent factors: noise, facilities, and economics.

Helicopters in Transport Service
IGOR I. SIKORSKY, Sikorsky Aircraft Div., United Aircraft Corp.
Let's look into the near future at the new helicopters which will soon be serving us in both normal and emergency operations—and estimate their speed, size, and other characteristics.
(Sponsored by Air Transport Activity)

Friday, Jan. 15

Grand Ballroom
The Sheraton-Cadillac Hotel

9:30 a.m.

Chairman—J. W. PENNINGTON, Koppers Co.
Secretary—R. S. FRANK, Caterpillar Tractor Co.
AIR SUPPLY TO THE ENGINE

New Developments in Turbocharging
RUDOLPH BIRMANN, De Laval Steam Turbine Co.
High-pressure turbocharging suggests new power futures for two- and four-cycle diesel and spark-ignition engines. On the horizon are higher output and lower fuel consumption.

Development of the McCulloch Supercharger for Automotive Diesel and Gasoline Engines
J. W. OEHRLI, McCulloch Motors Corp.
Triple-dimension—words, pictures, and model—exposition of a supercharger which boosts power, incorporates a unique variable-speed drive, is quiet, fast, and economical.
(Sponsored by Diesel Engine Activity)

2:00 p.m.

Chairman—JOHN DICKSON, Detroit Diesel Engine Div., General Motors Corp.
Secretary—G. W. CONOVER, Detroit Diesel Engine Div., General Motors Corp.
Business Session of Diesel Engine Activity

The Free-Piston and Turbine Compound Engine—Status of Development
A. L. LONDON, Stanford University
Marriage of the gas turbine with the reciprocating engine in the free-piston and turbine compound engine produces spectacular advantages in terms of torque-speed characteristics, compactness, mechanical simplicity, and fuel economy.
(Sponsored by Diesel Engine Activity)

Grand Ballroom, Hotel Statler

9:30 a.m.

Chairman—H. R. BOYER, Cadillac Tank Div., General Motors Corp.
Secretary—J. H. MURPHY, Air Transport Section, General Motors Corp.

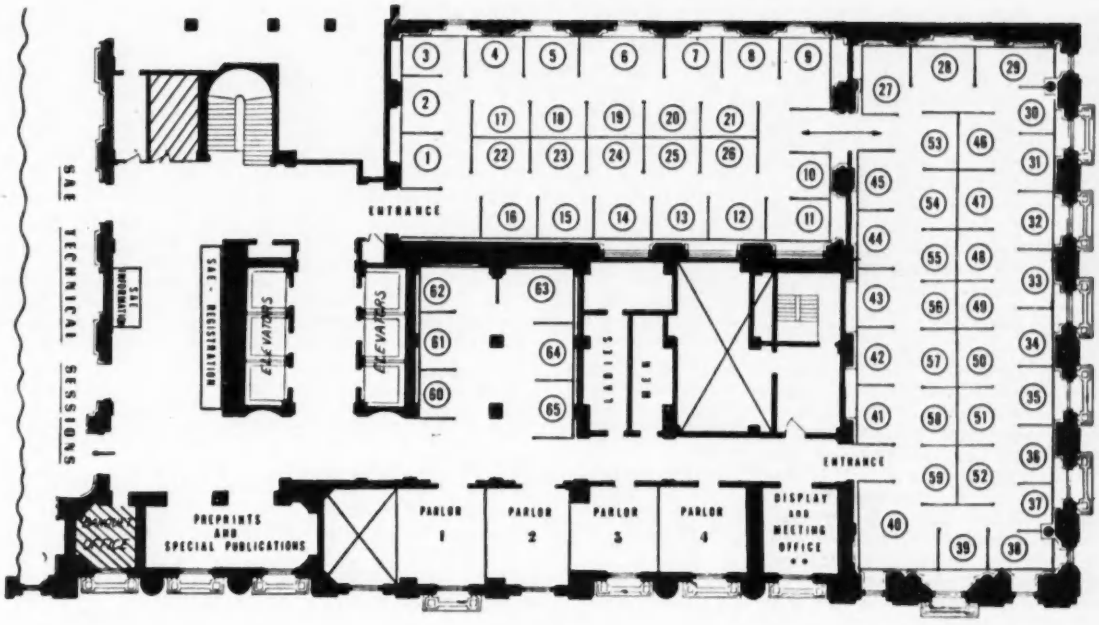
The Modern Executive Plane as a Medium of Transportation
W. P. LEAR, Chairman of the Board, Lear, Inc.
Should executive aircraft for VIP's have reciprocating engines, turboprops, turbojets, or ducted fans . . . two engines or four engines? Should they have pressurization? Do they need more passenger-carrying capacity?

Prepared discussion by:
PAUL BUTLER, Butler Aviation
H. O. FISHER, Port of New York Authority
W. C. JAMOUNEAU, Piper Aircraft Corp.
C. H. MORROW, J. I. Case Co., and Chairman of the Board, National Business Aircraft Association, Inc.
E. T. PEABODY, Air Transport Section, General Motors Corp.
HERB RAWDON, Beech Aircraft Corp.
TOM SALTER, Cessna Aircraft Co.
(Sponsored by Air Transport Activity)

Engineering Display

SAE 1954 Annual Meeting

Fourth Floor, The Sheraton-Cadillac Hotel



Exhibitor List

Location Company

Parlor
1. Zollner Machine Works
2. Cleveland Graphite Bronze Co.
3. Aluminum Co. of America
4. Ross Gear & Tool Co.

Booth
1. American Bosch Corp.
2. Cities Service Oil Co.
3. Oil Hydraulic Div., Webster Electric Co.
4. Continental Motors Corp.
5. Dualoc Drive, Inc.
6. Gemmer Mfg. Co.
7. Brush Electronics Co.
8. Lord Mfg. Co.
9. Fram Corp.
10. Koppers Co., Inc.
11. Campbell, Wyant & Cannon Foundry Co.
12. Consolidated Engineering Corp.
13. Detroit Aluminum & Brass Corp.
14. Redmond Co., Inc.
15. Aluminum Industries, Inc.
16. LeRoi Co.
17. McQuay-Norris Mfg. Co.
18. Aeroquip Corp.
19. Waldes-Kohinoor, Inc.
20. Johnson Bronze Co.
21. Cummins Engine Co., Inc.
22. Monroe Auto Equipment Co.
23. Torrington Mfg. Co.
24. Pierce Governor Co., Inc.
25. Groov-Pin Corp.
26. Schwitzer-Cummins Co.
27. Sun Electric Corp.
28. Garlock Packing Co.
29. E. I. du Pont de Nemours and Co., Inc.
30. Wayne Engineering Research Institute
31. Auto Specialties Mfg. Co.
32. Perfection Stove Co.
33. Sparton Automotive Division, Sparks-Withington Co.
34. Kelsey-Hayes Wheel Co.
35. Anchor Coupling Co.
36. Heli-Coil Corp.
37. Automotive & Marine Products Corp.
38. Vickers, Incorporated
39. Bendix Products Division, Bendix Aviation Corp.
40. Bendix Radio Div., Bendix Skinner Div., Eclipse Machine Div., Marshall-Eclipse Div., and Scintilla Div. of Bendix Aviation Corp.
41. Waukesha Motor Company
42. Automotive Rubber Co., Inc.
43. The Leece-Neville Co.
44. The MB Mfg. Co., Inc.
45. The Buda Co.
46. Titeflex, Inc.
47. Allen B. DuMont Laboratories
48. Link Engineering Co.
49. Novi Equipment Co.
50. Wallace & Tiernan Co., Inc.
51. Goodyear Aircraft Corp.
52. Bohn Aluminum & Brass Corp.
53. Lisle Corp.
54. Rosán, Inc.
55. General Plate Division, Metals & Controls Corp.
56. Spencer Thermostat Division, Metals & Controls Corp.
57. Motor Products Corp.
58. Flex-O-Tube Division, Meridan Corp.
59. Fulton Sylphon Division, Robertshaw-Fulton Controls Co.
60. Spicer Mfg. Division, Dana Corp.
61. Hughes Aircraft Co.
62. Victor Mfg. & Gasket Co.
63. Stewart-Warner Corp.
64. Hercules Motors Corp.
65. Hercules Motors Corp.

Results Analyzed in Second Round Of Oil Filter Test Contaminant Trials

RESULTS of a second round of cooperative testing on an oil filter test contaminant proposed for standardization have led the Filter Test Methods Subcommittee to conclude that:

1. Chemical analyses performed by different laboratories on the contaminant known as SOFTC No. 1 check reasonably well. ("SOFTC" comes from "standardized oil filter test contaminant" and is pronounced "soft see." It is derived from used crankcase oil.)

2. The gear pumps used to keep the contaminant add supply in dispersion may possibly be grinding the contaminant particles up into smaller and smaller sizes. This conclusion was suggested by the fact that most of the laboratories found that the second and third filter elements tested had progressively greater difficulty in removing the contaminant.

These conclusions were reached at a meeting of the subcommittee held November 3 in Chicago.

The fact that chemical analyses of the contaminant checked is important to the subcommittee because it indicates that the mixture is uniform. Possible differences between dirt samples were suspected—along with differences in method of storage and agitation—to be responsible for poor correlation among results reported by various labs in an earlier series of tests.

The subcommittee expects to specify only petroleum ether insolubles and water content, if the test contaminant is agreed upon for standardization. They plan not to specify composition more exactly because they want the test contaminant always to be representative of the material encountered by filters in actual contemporary service. Crankcase sludge composition can be expected to change, they point out, as engines, fuels, and lubricants change.

The contaminant used in the current test program is obtained from a commercial chemist who collects used crankcase oil and stores 500 gallons or more in an agitated tank. To make the test contaminant, he presses out the oil, leaving a cake of sludge. Then he breaks up the cake and mixes it with appropriate quantities of fresh oil and water. The mixture is then canned. Before it is used in tests, it again undergoes prolonged agitation.

The basic set-up is shown schematically in Fig. 1. The test contaminant is circulated continuously throughout the period of the test by a gear pump in the storage mixer system. Every eight hours, 800 cc of oil is withdrawn from the sump supplying the filter. Of this, 40 cc of the oil is analyzed for pentane and petroleum ether insolubles. The other 760 cc is mixed with 40 g of contaminant stock for an hour, then added to the sump supplying the filter. A gear pump moves the oil to the filter, and from the filter it drains back into the sump.

Each filter element is tested 100 hours. The tests already completed were run on an 8-hour shift basis. Further tests will be run for 100 hours continuous.

To determine whether or not the gear pumps used in the test set-up to agitate the add stock do grind up contaminant particles, two committee members have agreed to run the tests over again, mixing the stock with pumps which don't have the grinding action. (Gear pumps were chosen originally because they are cheaper.)

Another committee member agreed to run four filters simultaneously, still using the gear pump. The idea is that if the four filter elements run simultaneously on the same oil-dirt mixture give different results, the differences lie in the filter elements. If results are similar, the similarity will support the hypothesis that the gear pumps reduce contaminant particle size significantly during prolonged running.

A third committee member hopes to study particle size with an electron microscope. He has already tried a light microscope and found that most of the particles are too small to be resolved.

Subcommittee members include: W. A. Hunter of Chrysler as chairman, R. J. Pocock of Ford as secretary, R. C. Beckett of Walker Mfg., S. L. Earle of the Naval Engineering Experiment Station, F. B. Hunt of the Detroit Arsenal, W. S. James of Fram, E. D. Kane of Cuno Engineering, C. L. Lauer

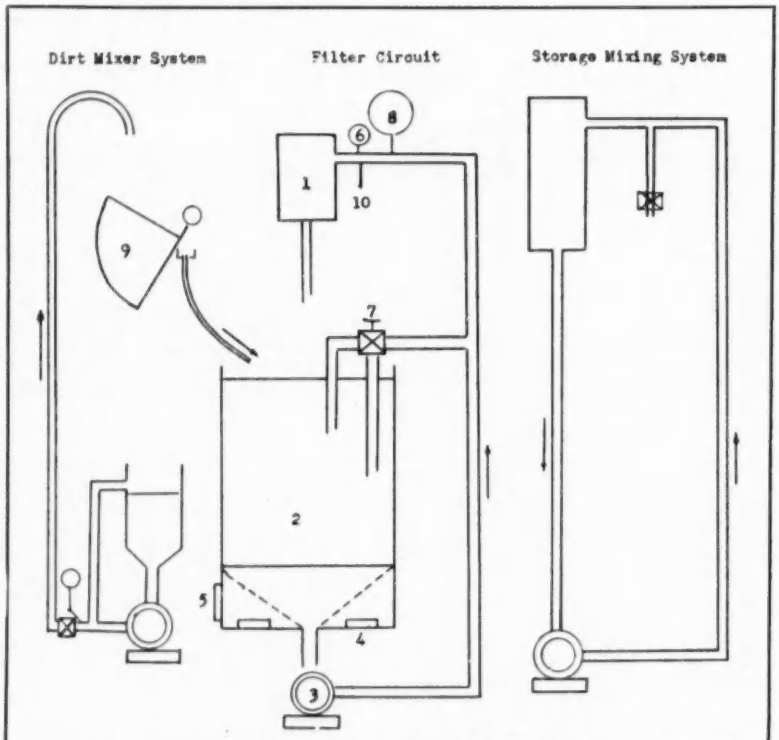


Fig. 1—Test set-up for running proposed oil filter test contaminant used in second round of cooperative testing

1—test filter
2—oil sump
3—gear pump
4—heating unit
5—thermostat
6—thermometer
7—pressure regulating valve
8—pressure gage
9—feeding quadrant
10—sample port

Attack Jet Fuel and Oil System Problems

FUEL and oil system problems introduced by today's faster, higher-flying jet planes are prime sources of interest to this group—Committee A-16, Aircraft Fuel and Oil Systems and Equipment. With its sights set on clarifying some of these design problems, A-16 members gathered recently in Los Angeles for two all-day sessions. Among other things, they discussed: (1) advantages and disadvantages of manual refueling systems as opposed to single-point ones for lighter-weight fighters; (2) devising a test procedure and test rig which will provide realistic performance data on flexible couplings, especially as pertains to their flexibility and ability to withstand vibration; and (3) the need for continued study of fuel tank protection, particularly the question of whether current safety devices are reliable and necessary. P. H. Jones, of North American Aviation, (standing in front of door) is chairman of this SAE Aeronautics Committee group.

of AC Spark Plug, and H. R. Otto of Purolator. The group is a subcommittee of the SAE Engine Committee.

For the test program, Ford is furnishing the contaminant, Fram the dirt agitator sumps and test oil, and Purolator the filter body and elements. The cooperating labs are those with which the Subcommittee members are associated.

Test Codes for Tractors Evaluated at Fort Belvoir

TWO proposed SAE test codes for rating reserve tractive ability and vehicle drag of self-propelled construction and industrial machines were put to the acid test recently at Ft. Belvoir, Va. It was a case of evaluators themselves being evaluated!

For four days over 30 engineers from industry and the military carried out evaluation tests of these test codes recently completed by Subcommittee XII of the SAE CIMTC: Test Code A—Determination of Reserve Tractive Effort and Reserve Tractive Horsepower; Test Code B—Determination

Houser Gets Standards Medal

P. L. Houser, International Harvester (right) is shown receiving the ASA Standards Medal from Roger E. Gay, ASA President. The medal, which was presented at the ASA Annual Meeting last October, is awarded for "having served the cause of the voluntary standards movement through leadership in the actual development and application of standards." Houser is both SAE representative on, and chairman of, ASA Sectional Committee B5, Small Tools and Machine Tool Elements.

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(Object of the reserve tractive ability test is to determine the ability of a vehicle to do useful work beyond that required to move the vehicle on a level test course. The vehicle drag test is designed to permit determination of the external force and power required to maintain travel speed over the test course.)

The tests were carried out on both a crawler vehicle and a rubber-tired vehicle. Instrumentation for conducting the tests was supplied by Allis-Chalmers, Goodyear, and the Engineering Research and Development Laboratory.

Several runs were made at different speeds and in each direction on the test course. In addition to keeping a complete log of test data, the observers made a photographic record (both motion and still picture).

On the basis of these tests, Subcommittee XII decided to write a guide explaining the technique for conducting tests in accordance with the two test codes. Also it was felt that the method for determining maximum reserve tractive effort and horsepower should be explained.

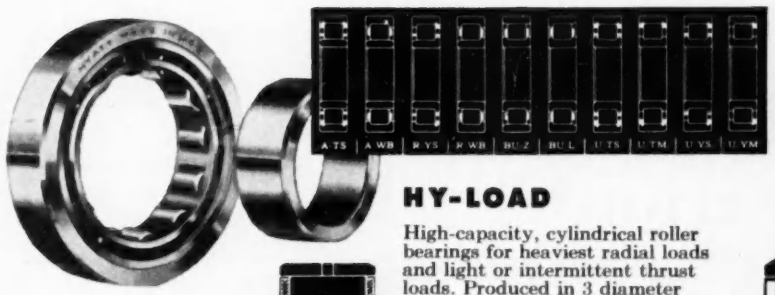
Subcommittee XII plans to present the complete picture of what took place during the Ft. Belvoir tests at the 1954 Earthmoving Industry Conference in Peoria. There, in April, three papers will be presented covering:

- Objectives of the test code. Why it is needed.
- Instrumentation used during the Ft. Belvoir tests, including description, method of using, and so forth.
- Results and evaluation of the actual tests.

In the meantime, the subcommittee is continuing work on the other six parts of the overall test code. These codes will permit determining fuel consumption, speed and acceleration, brake ability, steering loads and turning, gradeability, and tilt limitations.

This project was initiated at the request of the Corps of Engineers. It is aimed at helping the Corps fulfill its desire to have an "Evaluation Manual" for all of its rubber-tired and crawler tractors.

Euclid Road Machinery's H. L. Rittenhouse is chairman of this SAE Construction and Industrial Machinery Technical Committee group. Other subcommittee members present at the Ft. Belvoir tests were: P. J. Sperry and B. L. Fisher, International Harvester; J. Meier, Bucyrus-Erie; T. A. Haller, Allis-Chalmers; P. Spennetta, Caterpillar; J. C. Laegeler, F. G. Hough Co.; D. K. Heiple, LeTourneau-Westinghouse; W. P. McKusick, Goodyear. Other observers present at the tests were: W. C. Johnson, R. M. MacFarland, and W. H. Cohern, Goodyear; C. A. Murphy, Allis-Chalmers; A. Altman and J. Hyler, LeTourneau-Westinghouse; Col. G. L. Coates, Association of Manufacturers of Contractors



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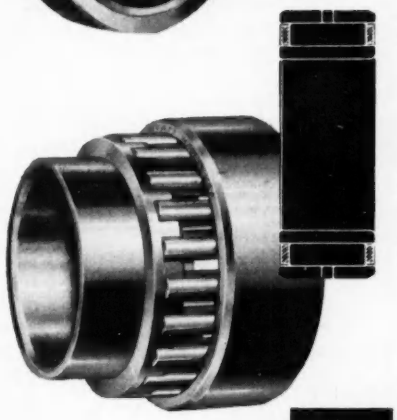

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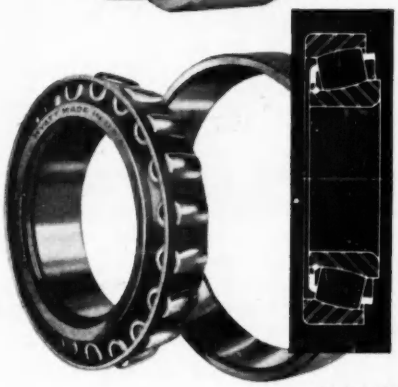

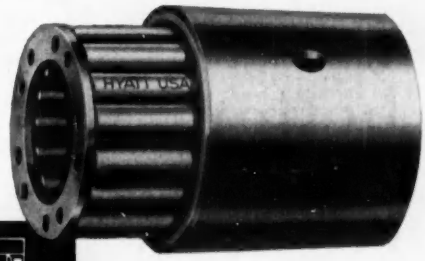

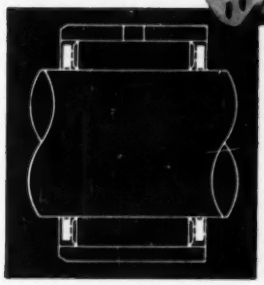

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4. It helps explain why Lockheed has an unequalled record of production stability year after year.

report on diversification at Lockheed

diversified development projects

The most diversified development program in Lockheed's history is under way—and it is still growing. Lockheed recently announced contracts for the highly advanced XF-104 fighter and a study of nuclear energy applications to aircraft. Other projects include work on jet transports and missiles.

diversified production

The result of diversified development in the past can be seen in the wide range of planes now in production. Huge luxury airliners, cargo transports, jet fighters and trainers, bombers and radar search planes are rolling off Lockheed assembly lines. Twelve models are in production.

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thermodynamicists "A"

thermodynamicists "B"

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New ISTC Division To Study Sheet Suffixes

THE SAE Iron and Steel Technical Committee has formed a new division to consider standardization of certain designations for sheet steel. It will be Division XXXII.

As it is now, some users of sheet add the suffix "A" to denote cold rolled sheets or coils for exposed automobile body parts and "B" for unexposed body parts. Other users apply "A" to unexposed parts and "B" to exposed parts.

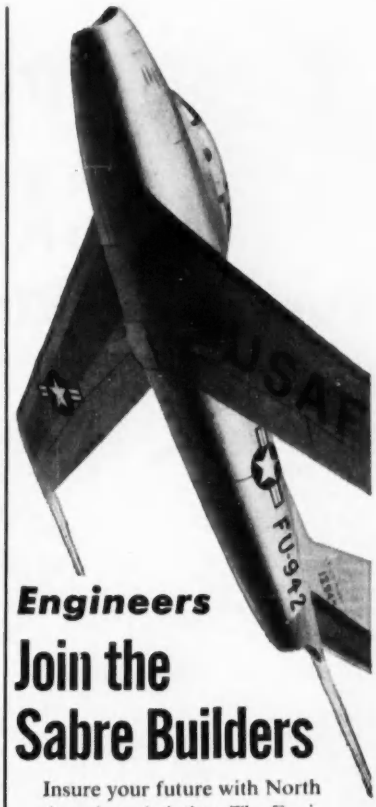
The new division's mission is to try to end this confusion. Among its membership will be men familiar with sheet users' problems and men familiar with sheet suppliers' problems. A. H. Smith, chairman of ISTC Panel C—Automotive Users has named to the division R. L. Bidwell of Chrysler, S. R. Callaway of General Motors, Joseph Gurski of Ford, F. G. Hehn of A-C Spark Plug, Morris Kosten of Ford, Homer Pratt of Fisher Body, Wesley Ravell of Briggs Mfg., and A. D. Wagner of Hudson.

C. L. Kent, chairman of Panel A—Steel Producers, has named to the division F. F. Aloi of Bethlehem Steel, W. E. Bayers, Jr., of Great Lakes Steel, Charles Buker of Jones & Laughlin, R. S. Burns of Armco Steel, R. Guthrie of Ford, E. F. Lundeen of Inland Steel, W. Rodgers of Republic Steel and H. L. von Ende of Bethlehem Steel.

Tips on Designing Truck Dock Facilities

SOLID clues on how to design docking facilities for trucks can be found in a new SAE recommended practice. They're average vehicle dimensions for commonly used trucks and tractor semitrailers—information that dock designers must know to be able to design efficient dock facilities. As a further aid to dock designers who know beforehand whether the dock is to be used for city-delivery or over-the-road vehicles, the report lists separate figures for each of these types.

In short, the SAE T&M Loading Platform Heights Subcommittee has done its best to make this recom-



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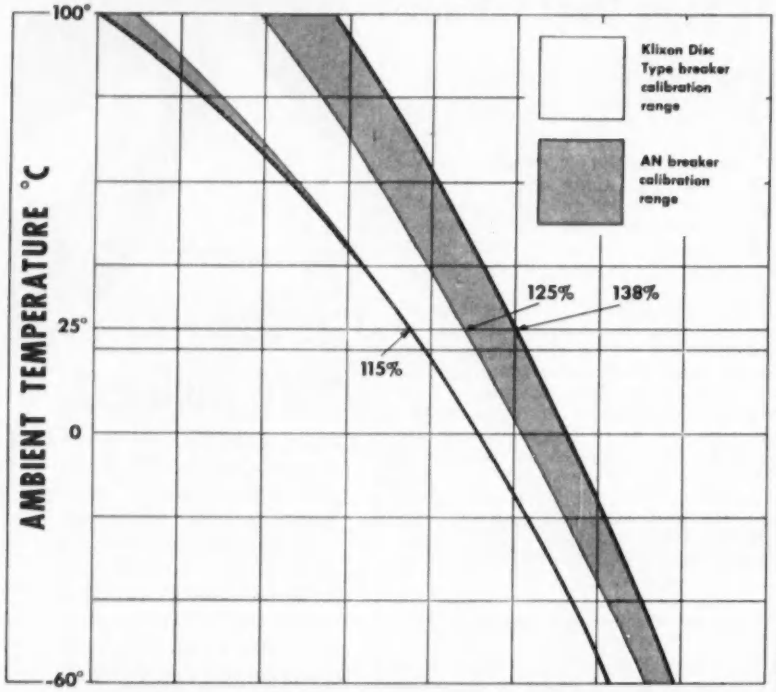

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Klixon circuit breakers withstand shock and vibration far in excess of the values normally secured. All sealed types are *explosion-proof, corrosion* and *humidity resistant.*

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TYPICAL KLIXON DISC TYPE BREAKERS

PSA Automatic Reset
Ratings: 2 to 35 Amps
Weight: 1 oz.

PDM Manual Reset
Ratings: 15 to 40 Amps
Weight: 1.7 oz.

KLIXON

SPENCER THERMOSTAT
Division of Metals & Controls Corporation
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mended practice "all things to all people."

Besides listing average vehicle dimensions (overall height, width, and empty floor height), the report also touches on dock gradient. It recommends that the maximum gradient at docks should not exceed 6%.

Members of the subcommittee that prepared this SAE Recommended Practice on Average Vehicle Dimensions for Use in Designing Docking Facilities for Motor Vehicles were: A. W. Neumann, Willett Co., Chairman; A. W. Baumgarten, Ebasco; W. L. Bennett, Baltimore Transfer; W. D. Bixby, United Parcel Service; R. L. Hardgrove, Liberty Highway Co.; E. B. Ogden, Consolidated Freightways; and Hoy Stevens, Bureau of Public Roads.

What's Coming in SAE Aero Materials Specs

TWENTY-THREE proposed new and revised specifications are being circulated to industry for review and comment by the SAE Aeronautical Materials Specifications Division. Copies of these specifications are available from the SAE Aeronautical Department.

Eleven new and revised specifications have been approved recently by the SAE Technical Board.

The proposed specifications are:

- AMS 2241C—Tolerances, Corrosion and Heat Resistant Steel Bars;
- AMS 2430B—Shot Peening;
- AMS 3130B—Paint Vehicle, Glyceryl Phthalate;
- AMS 3213F—Synthetic Rubber, Aromatic Fuel Resistant (75–85);
- AMS 3215F—Synthetic Rubber, Aromatic Fuel Resistant (65–75);
- AMS 3232G—Asbestos and Synthetic Rubber Sheet, Hot Oil Resistant;
- AMS 3270C—Synthetic Rubber Sheet, Cotton Fabric Reinforced, Weather Resistant—Chloroprene Type;
- AMS 5085—Steel Sheet and Strip 0.47–0.56C (SAE 1050);
- AMS 5315—Ductile Iron Castings (Nodular), 60,000 psi Tensile;
- AMS 5316—Ductile Iron Castings (Nodular), 80,000 psi Tensile;
- AMS 5536—Alloy Sheet, Corrosion and Heat Resistant, Nickel Base 22Cr-1.5Co-9Mo-0.6W-18.5Fe;
- AMS 5576A—Steel Tubing, Welded, Corrosion and Heat Resistant, 18Cr-10Ni-Ti (SAE 30321);
- AMS 5591B—Steel Tubing, Seamless, Corrosion Resistant, 12.5Cr (SAE 51410);
- AMS 5613C—Steel, Corrosion and Moderate Heat Resistant, 12.5Cr (SAE 51410);
- AMS 5754—Alloy, Corrosion and Heat Resistant, Nickel Base 22Cr 1.5Co-9Mo-0.6W-18.5Fe;
- AMS 6323C—Steel Tubing, Mechani-

cal 0.5Cr-0.55Ni-0.25Mo (0.38–0.43C) (SAE 8740);
• AMS 6328C—Steel 0.5Cr-0.55Ni-0.2Mo (0.48–0.53C) (SAE 8750);
• AMS 6413C—Steel Tubing, Mechanical 0.8Cr-1.8Ni-0.25Mo (0.35–0.40C) (SAE 4337);
• AMS 6415E—Steel 0.8Cr-1.8Ni-0.25Mo (0.38–0.43C) (SAE 4340);
• AMS 7270B—Rings, Sealing, Synthetic Rubber, Fuel Resistant (65–75);
• AMS 7274C—Rings, Sealing, Synthetic Rubber, Oil Resistant (65–75);
• AMS 7470A—Bolts and Screws, Steel, Corrosion Resistant, Heat Treated Roll Threaded;
• AMS 7456C—Studs, Steel, Alloy Heat Treated—Roll Threaded.

The approved specifications are:

• AMS 3087C—Compound, Insulating and Sealing;
• AMS 3170B—Thinner, Alcohol—Ester;
• AMS 3641A — Plastic Moldings, Thermosetting;
• AMS 4756—Solder;
• AMS 5528—Steel Sheet and Strip, Corrosion Resistant;
• AMS 5352—Steel Castings, Precision Investment, Corrosion Resistant;
• AMS 5361B—Steel Castings, Sand and Centrifugal, Corrosion and Heat Resistant;
• AMS 5615B—Steel, Corrosion and Moderate Heat Resistant;
• AMS 5647—Steel, Corrosion and Heat Resistant;
• AMS 5053B—Steel Tubing, Welded, Low Carbon, Annealed;
• AMS 6351—Steel, Sheet and Strip.

A-B-C Nonferrous Specs Compiled in One Big Book

SAE Standards and SAE Aeronautical Materials Specifications are among those referenced in a huge new compendium of nonferrous-metals specifications in use in Austrialia, Canada, the United Kingdom, and the United States. Metals covered are aluminum, copper, lead, magnesium, nickel, silver, titanium, and zinc.

The book is titled "ABC-ARMY-STD-20, Non-Ferrous Metals and Alloy Specifications." This book, like its companion volume "ABC-ARMY-STD-2, Catalogue of Ferrous Alloy Specifications," was prepared under the auspices of the American-British-Canadian Armies Standardization Program.

For each metal, the nonferrous catalog groups in one section the designations for specifications covering equivalent or similar materials. Another section summarizes chemical and mechanical properties from each specification.

The book was compiled by Canadian Arsenals Limited and is available at $12 postpaid from Canadian Standards Association, National Research Building, Ottawa.

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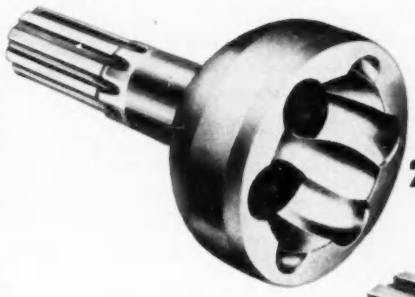

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Transmits rotary motion from one shaft to another—uniformly, smoothly. Hardened steel balls roll in grooved raceways, providing true rolling action.

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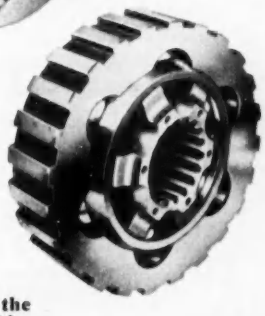
Up to 35°! No variation in relative angular velocity is possible.



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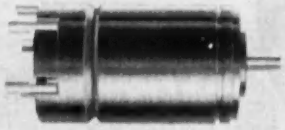

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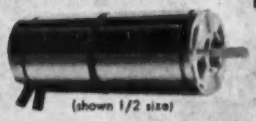

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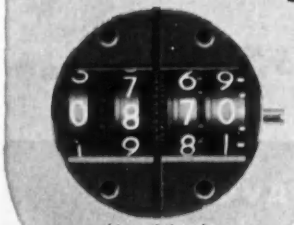

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About SAE Members

Continued from Page 79

assumed operation of the Buda Co., Harvey, Ill. This addition will be operated as "The Buda Co., a division of Allis-Chalmers."

BURNHAM ADAMS, sales manager for AiResearch Mfg. Co. for the past three years, has been appointed to the newly-created post of manager-sales, field service and contract administration, in Pacific Airmotive Corp.'s Manufacturing Division.

Adams

Parton

CLYDE PARTON has been appointed director of engineering for the Aeronautical Division of Minneapolis-Honeywell Regulator Co. He was formerly manager of the company's aeronautical office in Los Angeles.

DONALD S. McARTHUR, chemical engineer at the Standard Oil Development Co., is author of "Statistical Evaluation of a Test Procedure." This paper was presented at a joint meeting of the Analytical Sub-Group of the Delaware Section, American Chemical Society, and the Wilmington Chapter of the American Society for Quality Control.

JOHN E. HACKER, who was acting works manager of the Electro-Motive Division, GMC, in La Grange, Ill., is now manager of GMC's Plant No. 3, Electro-Motive Division, at Cleveland. Hacker is a past vice-president representing production engineering and a past chairman of the Cleveland Section.

JAMES G. RAE is with York Gears, Ltd., Toronto, Canada, as general manager. He was general works manager for the Canadian Acme Screw & Gear Co. in Toronto.

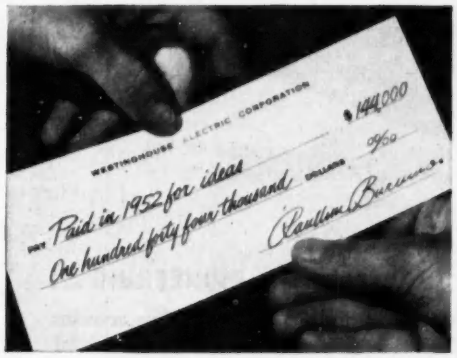
DR. R. E. WILSON, chairman of the Board, Standard Oil Co. of Indiana, will address the opening luncheon of the 15th Annual Meeting of the National Council of Private Motor Truck Owners, Inc. This meeting will be held in Chicago next January 28 and 29. His topic will be "Strategy

Continued on Page 106

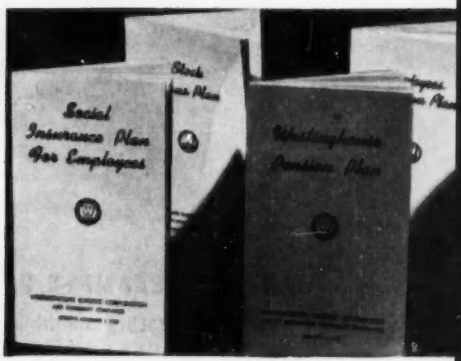
Look at these new opportunities in jet engineering at Westinghouse

1. Immediate openings in research, development and manufacturing at our Aviation Gas Turbine Division in Philadelphia or Kansas City, Mo. Salaries are good, varying with experience and ability. You'll enjoy working with us.

2. Challenging work offers the opportunity of joining with Westinghouse, a long-time leader in jet engineering.



3. Incentive awards are given for inventions and ideas. Creative work is recognized and rewarded. We even pay your tuition for graduate study.



4. "Extras" include a modern pension plan; low-cost life, health, and accident insurance; stock purchase plan.

5. Security we consider important. Promotion is from within. We're in this new, expanding industry to stay.

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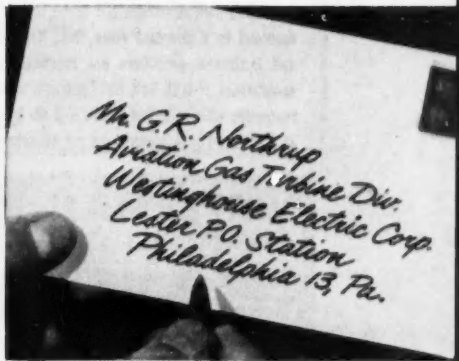

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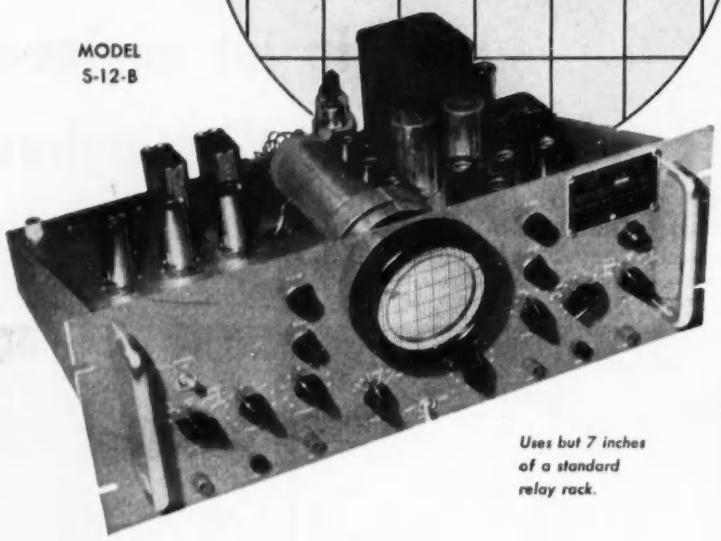

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About SAE Members

continued

for True Liberals". SAE members on the Committee of Program and Arrangements are: **Z. C. R. HANSEN,** vice-chairman, Diamond T Motor Car Co.; **O. A. BROUER,** head of the General Automotive Division, Swift & Co.; **M. E. COWDEN,** manager of the delivery department, American Bakeries Corp.; **A. H. KREUDER,** superintendent of Motor Transportation, Wilson & Co.; and **H. O. MATHEWS,** general manager of transportation and distribution, Armour & Co.

FLOYD HARTSHORN is now district manager of the Milwaukee office for The Timken Roller Bearing Co.'s Milwaukee Industrial Sales Division. Hartshorn, who started with Timken in 1937, has been connected with the Milwaukee sales office since 1939 except for service as a Navy lieutenant in World War II.

Hartshorn

Van Orman

DONALD VAN ORMAN has become manager of industrial sales for the Minneapolis district for The Timken Roller Bearing Co. He was previously a field engineer for the company in Minneapolis.

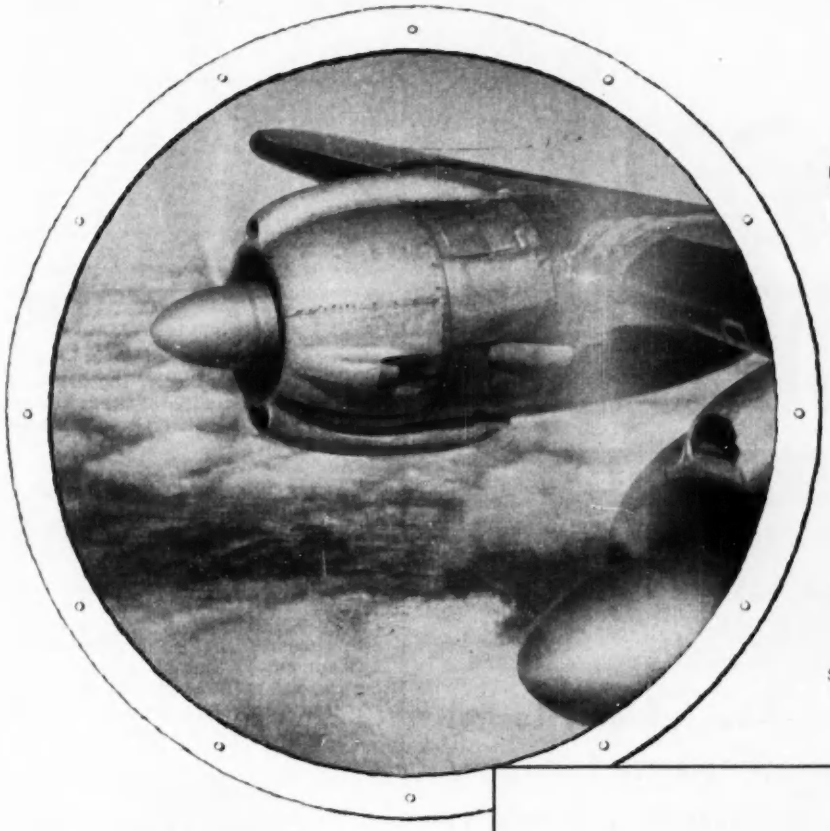
BERNARD E. RICKS has become manager of the Fruitport Works, Thompson Products, Inc. He was formerly assistant chief engineer for Thompson in Detroit.

DON A. LAWLESS is now a standards engineer for the Sperry Gyroscope Co., of Great Neck, N. Y. He was previously a metallurgist with Sam Tour & Co., Inc., New York.

PAUL L. GRANEY has become senior layout draftsman for Chevrolet Motor Division, GMC Detroit. He was formerly project engineer in the Chevrolet Aviation Engine Division, GMC.

CLYDE E. WILLIAMS, director of Battelle Memorial Institute, Columbus, Ohio, has been named a member of the permanent advisory panel on minerals research for the National Science Foundation, Washington, D. C. The

Continued on Page 108



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Time is always flying. You can save some of your time by flying, too. Yes, ride the airlines regularly. You'll save moments, minutes, days, weeks to use as you choose—for business or pleasure. Next time... save time... *your* time. Fly!

You're looking out the window of a TWA Constellation at the Rohr-built "power packages" on the wing. For the Lockheed Constellation and other great airplanes, Rohr manufactures and assembles the engine mount, cowl panels, ducts, exhaust system, tanks, and other units which transform a Wright engine into a complete, ready-to-install "power package."

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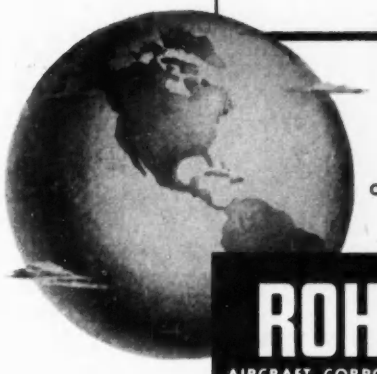

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85TH ANNIVERSARY 1868 ... 1953 COMPANY

Cleveland 6, Ohio

About SAE Members

continued

panel will advise the Foundation in developing policy on basic research in mineral discovery and exploration.

DONALD B. MORSE has been appointed sales manager of the Scintilla Division of Bendix Aviation Corp. Morse has been with Scintilla since 1941.

PAUL J. PAPANEK, Eastern District manager for Marquardt Aircraft Co., has been elected assistant secretary of the firm. He will continue to be in charge of the Dayton office.

J. A. KEENETH, of Hicks & Keeneth, manufacturer's representatives, has announced that his company has been apponited Eastern and Canadian representatives for the Gill Electric Mfg. Corp., Redlands, Calif.

Green

ROY W. GREEN has been appointed to the sales staff of The Pierce Governor Co., Inc., Anderson, Indiana. Formerly with the Hoof Governor Co., Chicago, his new duties are those of a special assignment field man.

LLOYD F. COATES is with Wyandotte Chemicals Corp., J. B. Ford Division. He is manager of industrial, railroad, and aircraft sales, San Francisco district. Coates was previously general manager of Transocean Air Lines, Talchem Division, San Lorenzo, Calif.

WILLIAM R. BOHANNAN is with the Union Oil Co. of California as an engineer trainee in refining. Bohannan was a project engineer in the research department of the Phillips Petroleum Co., Bartlesville, Okla.

LEE J. BREGENZER is now senior methods engineer for the Westinghouse Airbrake Co., Industrial Products Division, Swissvale, Pa. He was formerly a mechanical design engineer for the Airport Engineering Division of the New York Port of Authority.

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...A Must for Blocking and Shipping

Ruggedly built, designed for maximum safety and continuous operation, the De Walt Industrial Power Saw is geared to the fast pace of the Automotive Industry.

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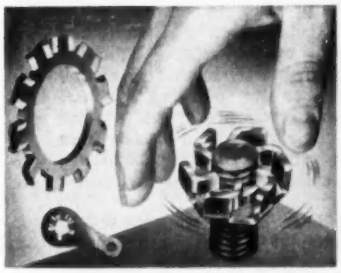
The De Walt Power Saw is only one of many AMF products which are helping the Automotive Industry and its suppliers to turn out *better products...faster...at lower cost!* Others are illustrated below. For further information on any AMF product write AMERICAN MACHINE & FOUNDRY COMPANY, General Products Group, 511 Fifth Avenue, New York 17, N.Y.



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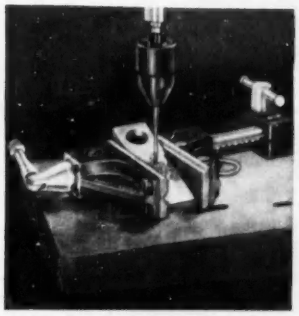

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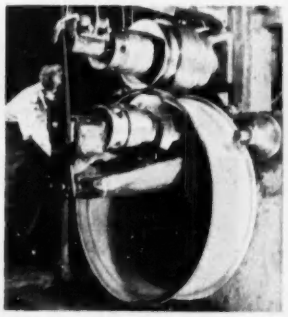
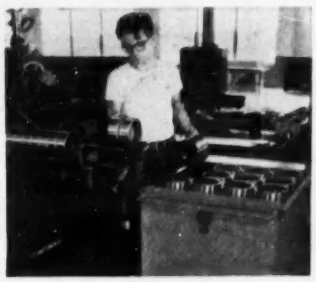


MAJOR SUPPLIER of rims and circular weldments for the Automotive Industry is AMF's Cleveland Welding Company.



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Stresses On Pilots Call for More Study

Based on paper by

A. M. MAYO

Douglas Aircraft Co., Inc.

THE attainment of higher altitudes in flying have tended to increase both the physical stresses and the physiological load on the human operator. But to continue the progress we must use the human decision maker more efficiently rather than overload his vital but limited capacities.

Difficulty in gathering and cataloging physiological data has made it necessary to concentrate on getting information on the effect of single stresses on subjects rather than to try to evaluate the complex interactions of the more realistic conditions of combined physiological stresses. Consequently, engineers often make the error of asuming that a man should be able to withstand the maximum values of several individual stresses simultaneously. This assumption is dangerous. Some of these stresses have a direct additive effect on the same body system and others individually affect more than one body system.

This problem can be illustrated by combining a condition of 10,000-ft cockpit altitude with the carbon monoxide concentration of 0.01% (both permissible under current flying regulations). This simple combination can reduce the oxygen saturation of the arterial hemoglobin to a value as low as 77% and thus cause a very substantial reduction in efficiency. It is not surprising, therefore, that these combinations of conditions with such additional effects as repeated accelerations from pull-outs after dives and "morning after" together with the normal psychological and physiological stresses of flying can at times end up in fatal accidents. More study of combined stress effects is needed in order to insure progress in reduction of the type of accident resulting from such vague causes as "pilot's error" or "target fixation." (Paper "Taking Man to Higher Altitude" was presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 1, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

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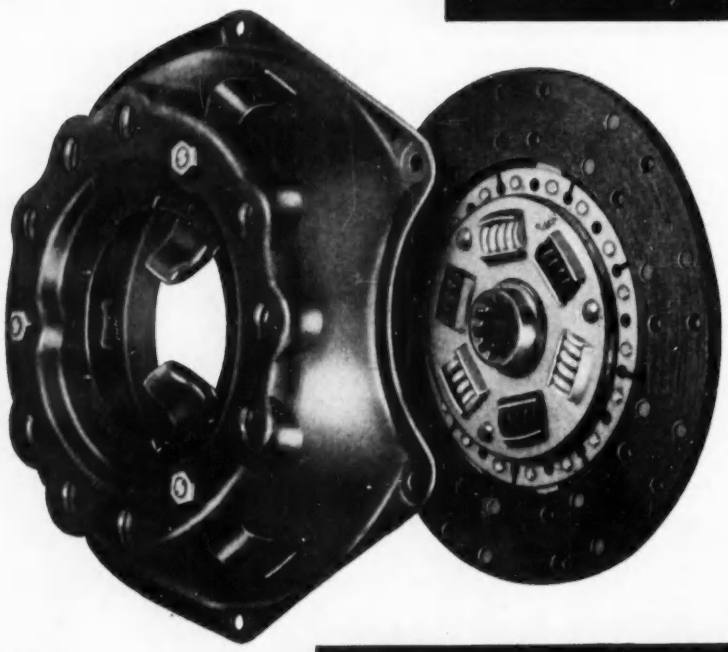

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E. A. DROEGEMUELLER
United Aircraft Corp.

and

H. N. TAYLOR
United Air Lines, Inc.

This paper appeared in full in the 1953 SAE Transactions

DOMESTIC airline use of a large number of 4-engine aircraft has intensified interest in reducing fuel consumption during cruise. This is manifested primarily in several airline service tests of the so-called "manual lean" cruise control procedure in place of cruise operation at automatic lean carburetor settings, or at best power fuel-air ratios with constant spark advance.

Manual lean operation appears to be more critical of fuel quality, particularly antiknock and volatility characteristics, and it also seems that significant improvement can be made in cruising economy with the average 1951 production fuels. This is possible because (1) partly through engine design, present cruise operating points are much further than necessary from

the knock-limited powers available with some specification fuels, and (2) because the average production aviation gasolines since the war have been considerably better than the specification requires.

Some field experience and test data indicate that the gain in cruising economy, available by more severe operating conditions, can be attained without jeopardizing engine reliability and with improvement in smoothness of engine operation, if the average 1951 fuel quality characteristics can be guaranteed, and if operators exert utmost diligence in maintenance of equipment and training of crew.

While the actual economies gained from tighter cruise control for a given airline would depend upon the particular equipment used and the route structure, it would seem that an improvement of 5 to 7% over best power-retarded spark cruise settings could be effected for the longer range aircraft. This would involve no significant engine modifications. (Paper "Aviation Fuel Economy and Quality—Brothers Under the Aircraft Skin" was presented at SAE National Aeronautic Meeting, New York, April 23, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Fuels and Lubes Can Lick the Cold

Based on paper by

J. A. MILLER

California Research Corp.

GASOLINES for starting at temperatures below – 30 F can be made, but their use is impractical because of possible vapor lock at high temperatures. Current gasolines are tailored to suit climatic conditions and combine reasonably low temperature characteristics with freedom from vapor lock. Starting aids must be used at temperatures below – 30 F.

Diesel fuels now available are generally satisfactory provided they are used at temperatures above their pour and cloud points, or means are provided to keep the fuel fluid at atmospheric temperatures below these limits. Cetane improvers have been used with success to improve the starting characteristics of low cetane fuel at relatively high ambient temperatures, but even a marked increase in cetane number will not result in ready starting at temperatures below freezing. Here again, starting aids must be used.

Of the various starting aids available, field experience has shown the most reliable and effective to the ether-base fuels. Starting diesel engines at temperatures below – 50 F with the aid of starting fluid is not unusual in the Arctic. Similar spectacular results have been obtained in gasoline engines, although aid is not generally required above – 25 F. Ether-base fluids can be introduced into an engine by spraying into the manifold through the air cleaner with a hand spray gun, or by injecting into the manifold with a primer pump mounted in the cab. Continuous idling to maintain temperatures should be avoided. Long periods of idling with the automatic transmission in the drive position has been the major cause for the failure of such transmissions during Arctic operation.

Winter lubrication must not only provide for low temperature starting, but also give satisfactory lubrication at temperatures where SAE 20 and 30 grade oils would normally be used. The SAE 5W oils meet these requirements. Some of them, when first developed, had the drawback of rela-

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tively high consumption, but most of those currently available give adequate oil mileage under high temperature conditions and are satisfactory from the standpoint of low wear and control of engine deposits. (Paper "Fuels and Lubricants Solve Cold Weather Driving Problems" was presented at SAE International West Coast Meeting, Vancouver, B. C., Canada, August 19, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

Radioactive Cobalt Shows Ring Rotation

Based on paper by

J. M. CHANDLER

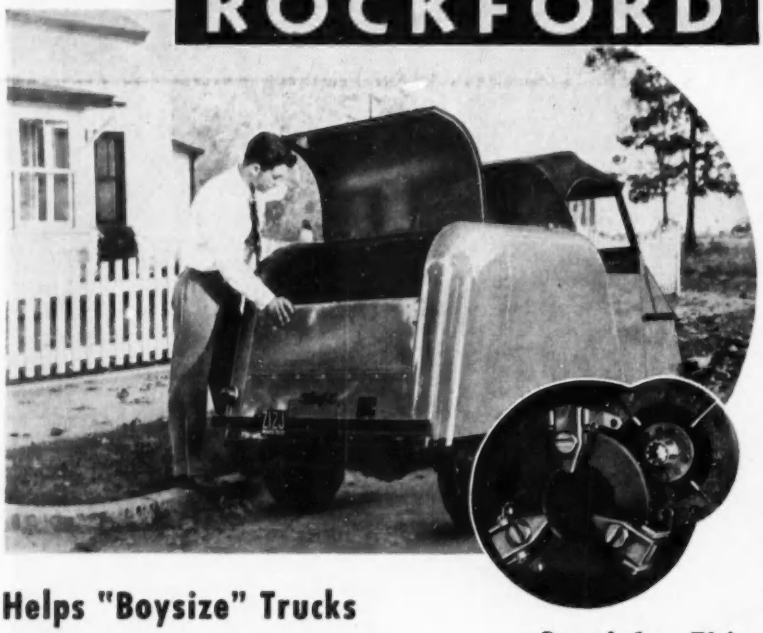
Ford Motor Co.

A DEVICE for determining piston ring rotation under any engine operating condition has been developed at the Radioactive Materials Laboratory of the Ford Motor Co. Radioactive cobalt is inserted in a cavity in a ring. The latter is then installed in a piston and placed in a test engine on which are mounted two Geiger counters. Since the radiation intensity will vary inversely as the square of the distance between the activity and the counter, the radial location of the ring in its groove can be determined by measuring the radiation intensity at the counters. As the recorded intensities vary, piston ring rotation in revolutions per minute and the direction of rotation can be determined.

Since all measurements are made external to the engine, it is felt that normal engine operating conditions are maintained. Only one ring can be checked at a time, but it is held that this disadvantage is offset by the advantage of being able to measure rotation under any condition desired.

(Paper "Recent Developments in Engine Instrumentation" was presented at SAE Summer Meeting, Atlantic City, June 9, 1953.)

CLUTCHES by ROCKFORD



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Heavy-Duty Vehicle Radiators Described

Based on paper by

FRED M. YOUNG

Young Radiator Co.

A FAIRLY complete discourse on heavy-duty type radiator construction together with a discussion of installation and operating problems are given by Young.

His descriptions of radiators built for specific applications are well backed with illustrations. The types depicted include those for tractors, power units, high-output diesel truck engines, and stationary equipment.

Young says that in matching an engine, radiator, and fan shrouding (if used), close cooperation is needed with the vehicle design group. He notes that potential capacity is planned and built into the radiator proper to a degree. Beyond that, output depends on factors such as fan performance, inlet and outlet air passages, pump performance, and piping or plumbing.

He notes that pump cavitation can stem from poor installation and operating practices, such as:

1. Overspeeding—running the pump beyond its efficient speed.
2. Undue static lift. The pump should always be mounted below the radiator bottom tank.
3. Poor piping practices, such as

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Trouble-free performance in millions of transmissions, universal joints, clutches, steering gears, governors, carburetors, generators, etc., has proved the Needle Bearing's ability to handle heavy radial loads. Standardization on Needle Bearings by the industry has meant safer, more comfortable driving—smoother, easier handling for America's cars.

Needle Bearings have been adopted as "standard equipment" throughout industry since their introduction nearly twenty years ago. They are the solution to anti-friction problems wherever high capacity, small size and easy installation are important.

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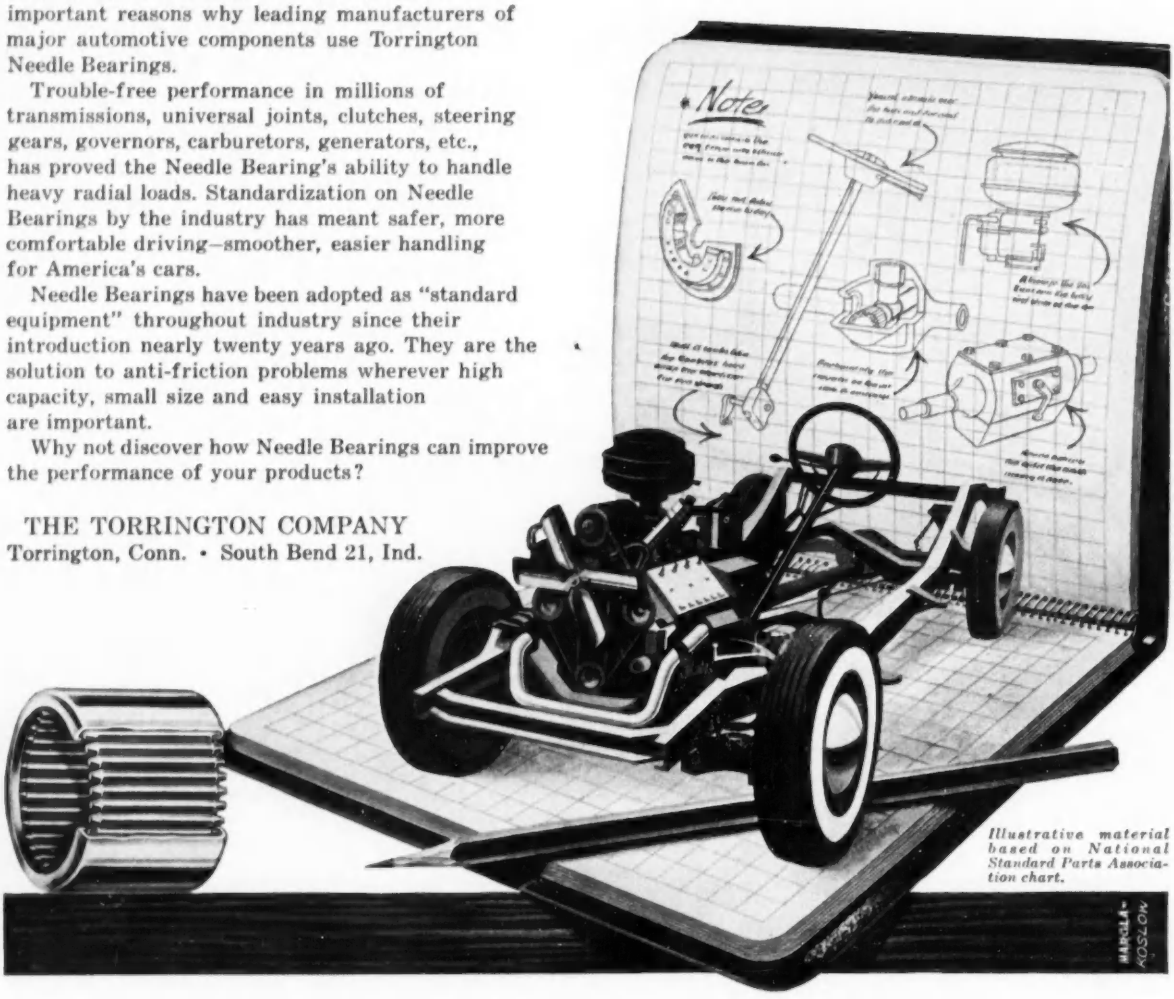

Illustrative material based on National Standard Parts Association chart.

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small connections, high velocities, and bad turns.

4. A decrease in atmospheric pressure which can come from a rise in altitude in mountain driving.

5. An increase in coolant temperature, which may be due to overheating caused by a dirty or plugged radiator.

Young recommends a pressurized cooling system as a way to prevent numerous troubles, including cavitation.

He says that to get the best performance from a well-designed cooling system, it is necessary to select proper water or prepared coolant, to use an inhibitor, and to keep clean the outside of the radiator, engine, pump, and plumbing. (Paper "Radiators for Power Units and Heavy-duty Vehicles," was presented at the SAE International West Coast Meeting, Vancouver, B. C. Aug. 18, 1953. It is available in full in multilithographed form from the SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Designing Oil Coolers For Converters Is Tough

Based on paper by

R. P. McDONOUGH
Harrison Radiator Division,
General Motors Corp.

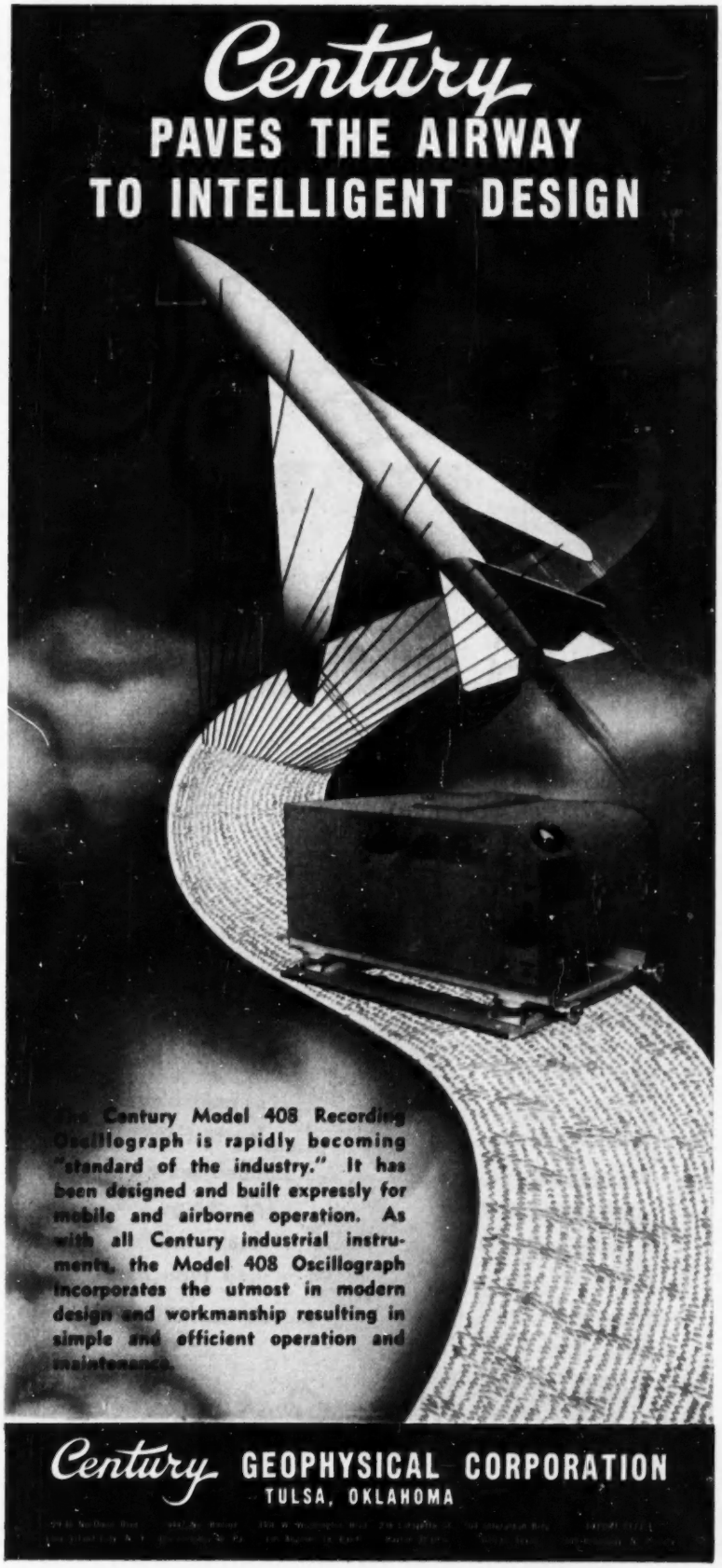
DESIGNING the compact, high-performance oil coolers that torque converters require isn't easy. First the designer has to determine:

- Whether it's best to transfer converter heat directly to the air stream . . . or indirectly to it through engine jacket water and radiator.
- Maximum oil temperature that can be tolerated.
- Rate of oil flow through torque converter from oil sump.
- Rate of cooling medium flow required to dissipate the heat.
- Maximum heat rate that must be handled.

Then, with this information and using well-established mathematical procedures, it is possible to calculate the size of the oil cooler required.

But the hardest job of all is yet ahead—that of finding space in the engine compartment for the oil cooler, no matter how small it is.

(Paper "The Development and Application of Oil Coolers for Torque Converters" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 15, 1953. It is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)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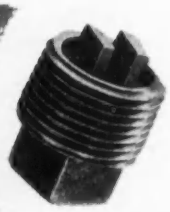

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New Members Qualified

These applicants qualified for admission to the Society between Oct. 10, 1953 and Nov. 10, 1953. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Baltimore Section

Harry Thomas Cline (M).

Buffalo Section

Peter M. Byam (M), Merle S. Day (J), Kenneth C. Engel (J), Holman S. Robertson (A), Willis Sprattling, Jr. (J).

Canadian Section

William George Beamish (M), Clayton A. Cook (M), Stanley John Frith (A), Gordon S. Manser (A), Harold G. Rahn (A), George McCaul Findlay Smith (M), Frank Stevenson (A).

Chicago Section

David F. Allen, Jr. (J), M. L. Davis (A), Ted del Solar (J), Bernard Johnson (J), Ray A. Trapp (M).

Cincinnati Section

LaVern D. Murray (J).

Cleveland Section

William H. Bergner (A), David Ralph Bonnes (J), Robert C. Brigleb (A), Milan A. Kontosh (M), Clyde R. Lang (A).

Colorado Group

Charles Beverly Gunn (A).

Dayton Section

Carl A. Anderson (J).

Detroit Section

Rupert B. Bell (M), Paul A. Bennett (J), John V. Capinjola (M), John A. Dobb (J), Joseph Richard Farnham (J), Peter J. Gallette (A), Werner E. Hamann (M), Edgar S. Haskin (A), Joseph M. Hodess (J), Walter Robert Irving (M), William H. Kuhn (J), R. Wayne Macy (J), Edwin John McCauley (M), Dale K. Pettry (M), Harold F. Pierce (M), Thomas G. Pillifant (M), Leroy Polenz (J), Harold L. Sharp (J), Vern Dean Shipley (J), John R. Thomson (J), George E. Tozer (J), Warren M. Wiese (J).

Indiana Section

William Woodrow Barton (J), Eugene Grant Matkins (J), Eugene S. Murphy (J).

Kansas City Section

Thorgrim E. K. Kjolner (J), Isadore Levitch (A).

New Members Qualified

continued

Metropolitan Section

Irving M. Bant (M), Eugene C. Lang (M), John P. Lauri (J), Joseph J. Mancusi, Jr. (M), Walter D. Myers, Jr. (M), Aaron Vanglish (J).

Mid-Michigan Section

Harry C. Doane (M), Burton Aloit Fierstine (J), Howard William Gray (A), Fred M. Ison (A), Kenneth F. Lehman (J), Edward E. Malloy (A), Darwin K. Sohmer (J).

Milwaukee Section

Leo Hopfensperger (J), H. Ward Olander (J), Robert J. Rink (M).

Montreal Section

Bernard Lortie (J), Jimmy Mair (A).

New England Section

Norman Henry Bell (J), Paul A. Hood (A), John Russell Thompson (A).

Northern California Section

Jack H. Herron (A), Bobby W. Malone (J).

Northwest Section

Robert L. Wilson (A).

Philadelphia Section

Carl Hunter Boas (J), Reginald D. Hartwell (J).

Pittsburgh Section

Fulton R. Magill (A).

San Diego Section

Herman L. Braasch (M), Robert Arthur Cox (J), John Ward Maloney (J).

Southern California Section

Walter E. Barthel (J), Clifton L. Englis (A), James R. Fluent (M), Jess W. Gardner (M), Louis Y. Kado (J), Milton L. Patrick (J), Carl C. Starbeck (M).

Southern New England Section

Oscar A. Levi (J), Robert Louis McLeod (J), Ervin E. Schiesel (M).

Texas Section

Homer E. Edwards (A), Laurel E. Goodloe (A).

Texas Gulf Coast Section

C. A. Welling (A).

Twin City Section

David H. Gruver (M), John Keith Zaiser (M).

Washington Section

Ivo M. Amaral (J), Wesley E. Schwieder (M), Fenner N. Spivey (J).

Western Michigan Section

C. Alkema, Jr. (J), Alfonse A. De Muro (M), John D. Krehbiel (J).

Wichita Section

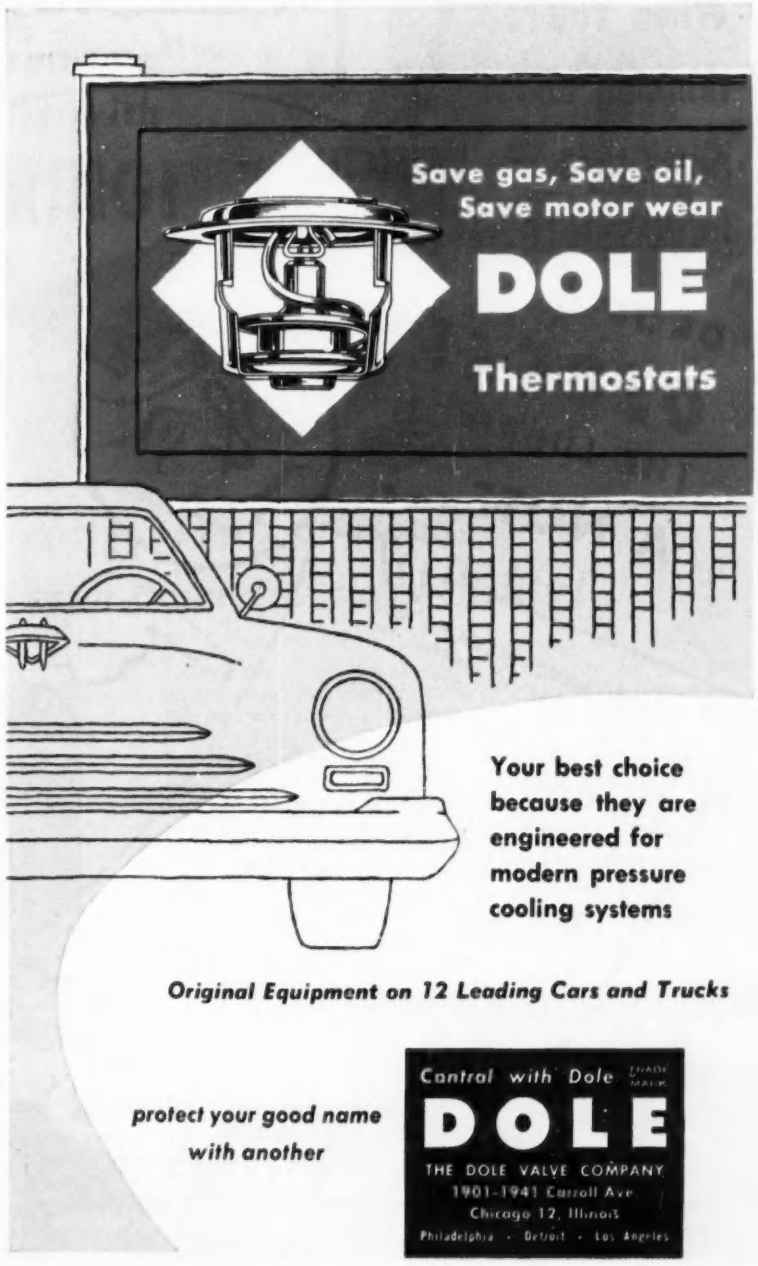
Howard J. Agnew (M).

Outside Section Territory

Robert Cohen (M), Clarence D. Hodgson (M), George Douglas Simonds, Jr. (J).

Foreign

Johannes Henri Boon (M), Holland; Paul Ivanyi (M), Brazil; Walter Keller (M), Switzerland; Marco Pierre (M), France; Robert Kyeu-Wo Suez (M), China.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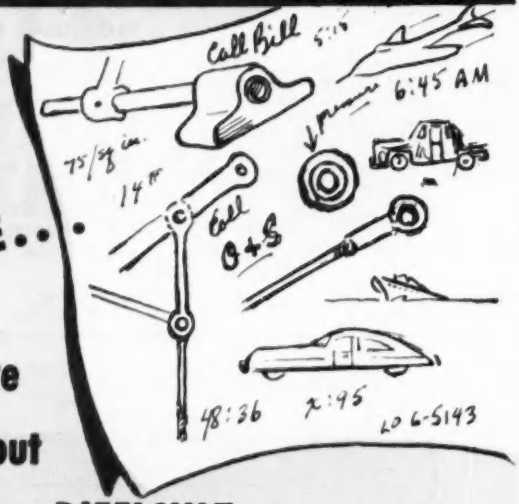

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Applications Received

The applications for membership received between Oct. 10, 1953 and Nov. 10, 1953 are listed below.

Atlanta Group

F. A. Buchanan, Jr.

Baltimore Section

Edward William Boyce, Edwin T. Plant.

British Columbia Section

Frank P. Moran.

Buffalo Section

Fred F. Allen, Manford Earl Folsom, William James Hazen, Jr., Douglas D. Joyce, Jr., Robert W. Kennedy, Edward Urycki.

Canadian Section

John M. Burch, R. H. Dexter, James W. Fry, H. W. Hoefer, George Andrew Sparrow, Donald Ross Winans.

Central Illinois Section

H. J. Alcorn, Samuel Richard Congram, Robert E. DuBois, Francis H. Hart, W. Neil Hediger, John H. Hyler, Bernard W. Kittle, LeRoy Lichtenstein, Jack L. McLaren, Chester L. Reid, Jr., Richard L. Robinson, Richard Addison Tolg.

Chicago Section

M. L. Conrad, Louis J. Filczer, Paul D. Gilson, William S. Hammel, William C. Klitzke, John M. Krizman, Matthew F. O'Brien, Edward P. Soder, Jr., Edward F. Tausk, J. Roy Wilhelm, Herbert A. Wilson.

Cincinnati Section

Henry Berg, Arthur R. Ehrnschwender, Thomas Evans, Royer M. Lake, Reginald P. MacDonald, Mason Noble, Alfred S. Withrow, Alexander Boyt Clarke, Robert E. Dyas, James R. Fotheringham, Albert John Garbin, William Cairns Leslie, Leight Kent Lydecker, Jr., Norman W. Smith, Robert C. Webster, George Martin Weisenberger, Herbert H. Wiedenmann.

Dayton Section

Joseph Francis Cattorini, James O. Helvern, Claude Hector May, Thomas M. Trainer.

Continued on Page 120

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This double-reduction Tandem Drive Unit is an outstanding example of Timken-Detroit engineering. Available with or without inter-axle differential, it incorporates a Straight-Line Drive with Hypoid-geared, top-mounted double-reduction final drives.

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Proved by billions of ton-miles of actual operation, this modern axle gearing offers slower gear ratios for use with today's higher-speed, higher-powered engines. It has the needed strength and rigidity to stand up under mile after mile of hard service. What's more, Timken-Detroit Hypoid gearing is available in a complete range of axle capacities. Whichever you choose—you benefit from the lower-cost operation, better performance and proved dependability of Hypoid gearing.

The next time you buy trucks make sure they're equipped with Hypoid-geared Timken-Detroit Axles and Brakes. You'll find them on the finest trucks built today.

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TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
Detroit 32, Michigan

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Applications Received

continued

Detroit Section

Ray M. Adsit, Meredith P. Albertson, Jr., Harvey J. Ankomeus, Roy Gilbert Baker, Charles R. Barnes, Hugh J. Byrd, Joseph Boyd, Edward S. Coe, Russell Andrew Crane, John M. Ericson, C. Fred Feindt, David Field, Donald Arthur Garner, Howard E. Geldhof, John C. Gilmer, John L. Gowie, Howard D. Hall, Jr., Zbigniew Jania, Melville G. Kennedy, Arthur F. Kessie, Jr., Theodore A. Kosydar, Norman C. Krupp, Jack Daniel Lawson, E. C. Lea, Norman H. Ledwan, Charles N. Mann, Arthur F. Martz, Jr., Walter Robert McLure, Ronald Philip Parkinson, George Popovich, Jr., Glenn T. Purdy, Charles R. Olnhausen, G. Raymond Reed, Stanley H. Reich, Watson S. Ricks, Jr., James George Roberts, Paul G. Roberts, Edward Saarinen, Herbert P. Schell, Fred L. Siebert, Howard M. Skovlund, Richard Herbert Smith, A. Gil Spear, Jr., Willard F. Speer, Annesley W. Stewart, David O. Thomas, Franklin Otto Thomas, Harry Thomas, Frank S. Treco, Jr., Charles Louis Trombley, Don Herbert Wacker, Patrick Wallace, Charles M. G. Wilder.

Hawaii Section

James H. Davis, Daton Floyd Elzey, Adam Noel Sonza, Albert B. Wells.

Indiana Section

Salvatore J. DiMilla, Glenn S. Farison, Corwin T. Geyer, Francis W. Manifold.

Kansas City Section

Robert Ewing Jones.

Metropolitan Section

Michael Bialkowski, G. Beakes Dickerson, Wallace J. Franklin, Charles H. Groezinger, Jr., Wayne H. Kimberlin, Eugene H. Koenig, Richard Walter Lace, Theodore McGill, Dominick Militello, Byron Nierenberg, C. J. Nuttall, Rubin Raskin, Walter Raskin, Alan Abraham Rawlings, George W. Taylor, Jr., Charles W. Wilson, Hanns H. Wolff.

Mid-Continent Section

Martin J. L. Dobson, Edmond J. Fox.

Mid-Michigan Section

Gordon B. Elder, Earl W. Pierce, Arnold T. Schmidt.

Milwaukee Section

Lionel H. Ames, Philip W. Fauntleroy, III, Arthur C. Flamme, Stanley F. Lindquist, David C. McMurray, Jr., Sheldon D. Pollow.

Montreal Section

Alphonse Grise.

New England Section

Edward E. Eldridge.

Northern California Section

George T. Coker, Jr., Don B. Duncan, James M. Hait, Thomas F. Mason, Frank D. Roberts.

Northwest Section

Aubrey William Albright, Elmore S. Buringrud, James A. Crozier, Donald H. Dehn, Robert B. Dickey, Kenneth R. Droppelman, Charles Royal Evans, Walter V. Ferguson, Jr., Roger E. Holmstrom, Richard C. Jones, Robert M. May, Matt W. Sokach.

Oregon Section

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Pittsburgh Section

Robert A. Petersen.

St. Louis Section

John W. Kourik, Eugene R. Livingstone, III.

San Diego Section

Leverett Wayne Cansler.

Southern California Section

Thomas R. Clark, Harry Eugene Cotrill, Jr., Richard M. Frincke, Robert Eugene Hutsell, Kenneth Jeanne Kahre, Harry M. Kellerman, James G. Myer, Charles B. Pearson.

Southern New England Section

William Arthur Dailey.

Syracuse Section

John Norris Hepworth, Kenneth H. Miller.

Texas Section

Paul E. Petty, William A. Romine, George C. Schaefer.

Texas Gulf Coast Section

Andrew E. Kennedy, Frank C. Love, Jr., Lee E. McDuff, Michael F. Slattery.

Twin City Section

Ralph C. Brown, M. J. McCarty, A. James Samways, Rahland C. Zinn.

Virginia Section

J. Harry Matthews.

Washington Section

Benson E. Gammon, Major Thomas E. Hauss, Nicholas P. Oglesby, Joseph S. Pelles, Jr., Flt. Lt. Tara Singh.

Wichita Section

C. L. "Chet" Dunbar.

Outside of Section Territory

Andrew G. Bilek, Harvey D. Carbiener, Richard Michael Deminski, W. J. Derksen, Lionel MacKenzie Gillies, Frederick Stephen Goodchild, Elwood J. Nicholson, Jr.

Foreign

Robert Edwin Butler, Australia; Anthony deBourbon, Brazil; Rozendo deSouza, India; Georges N. Bilger, France; David Lowe Forbes, Jr., India; John Langhard, Switzerland; Cedric Philips Lockton, England; Tokushiro Ohzato, Japan; Victor Prati, Argentina.

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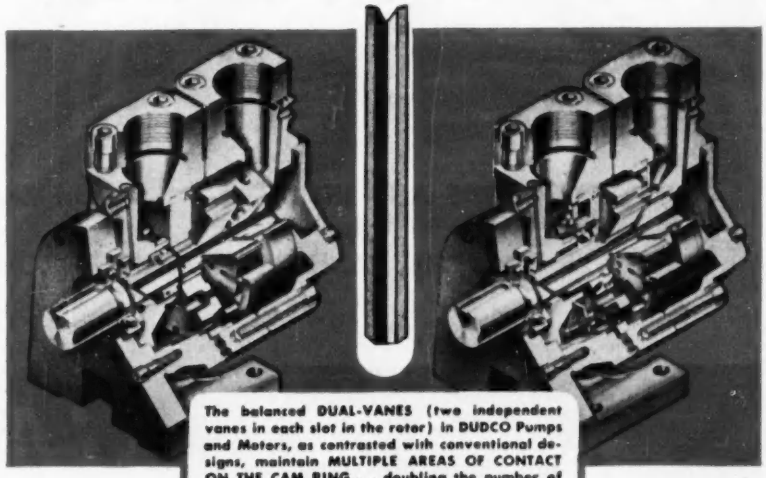


The balanced DUAL-VANES (two independent vanes in each slot in the rotor) in DUDCO Pumps and Motors, as contrasted with conventional designs, maintain MULTIPLE AREAS OF CONTACT ON THE CAM RING . . . doubling the number of effective barriers to slippage and power loss. This is an exclusive DUDCO principle!

DUDCO DUAL-VANE PUMPS

Low vane-thrust and low resistance to rotation PLUS minimized slippage combine to give the greatest horsepower output for given horsepower input. The patented DUDCO DUAL-VANE construction reduces slippage to an absolute minimum by providing multiple vane sealing . . . permits greater loads at higher pressures. DUDCO Pumps with over 60 standard models, a broad selection of port locations and types of mountings give design engineers the positive answer to fluid power requirements from 3 to 120 gpm at continuous pressures to 2000 psi. There are single Pumps from 3 to 60 gpm and double models provide combined capacities from 24 to 120 gpm. Here is compactness . . . over 100 hp in less than a cubic foot of space, rugged dependability in equipment supremely simple to service, and the most efficient fluid power units of their kind in the hydraulics field.

- **FULL HYDRAULIC BALANCE** . . . shaft bearing loads, rotor side loads and excessive vane-thrust loads and resultant wear are eliminated in the DUDCO design.
- **HIGHER PRESSURES** . . . 2000 psi continuous duty makes it possible to increase machine capacities using standard components.
- **INTERCHANGEABLE CAM RINGS** . . . enables users to alter the pump capacity simply by installing another size cam ring of the same series.

DUDCO DUAL-VANE MOTORS

The unique DUAL-VANE design enables DUDCO Motors to convert fluid power to variable speed rotary power with unmatched efficiency. Power losses due to slippage are virtually eliminated by the multiple vane sealing. These motors develop starting torques as high as or higher than running torques. They will start under load and may be stalled without damage. Dynamic balance and the low vane-thrust make possible rapid acceleration and deceleration . . . reversing is instantaneous. Over 25 standard models of DUDCO Motors are available to solve the problems of designers and engineers who must have a dependable source of rotary power. For continuous operation at pressures up to 2000 psi and speeds up to 3600 rpm, these Motors develop torques from 180 to 14,400 lb. in. . . . outputs, at maximum pressures and speeds, from 8 to over 120 hp.

- **SERVICEABILITY** . . . simplicity of design makes servicing easy though seldom necessary.
- **LONG LIFE** . . . rugged construction and minimized wear assure continued operation under the most grueling conditions without failure.
- **ECONOMY** . . . the most economical source of variable speed rotary hydraulic power.

Write Get the facts on DUDCO DUAL-VANE Pumps and Motors. Ask for Bulletin No. DP 300.

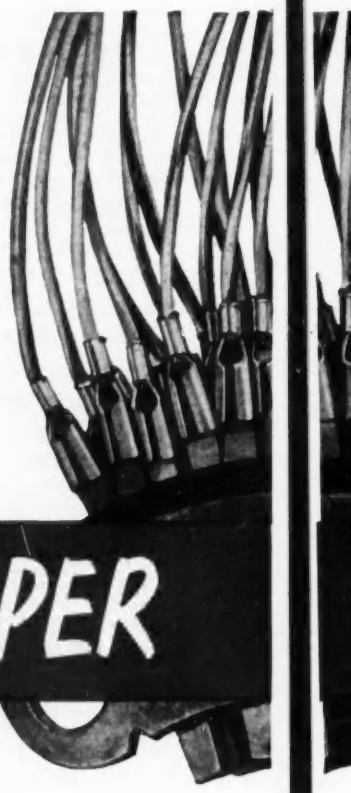
DUDCO DIVISION

THE NEW YORK AIR BRAKE COMPANY

1705 EAST NINE MILE ROAD • HAZEL PARK • MICH.

A NEW TERMINATION TECHNIQUE FOR . . .

- COMPUTERS
- SWITCHBOARDS AND INSIDE PLANT EQUIPMENT
- RELAYS, SWITCHES, AND MULTI-CIRCUIT COMPONENTS



AMP FLAT* TAPER

If you are concerned with the wiring of close spaced equipment, investigate the new AMP Solderless TAPER TAB RECEPTACLE for flat relay or switch tabs shown at right. It is self locking when installed on a male tab with matching 3½° taper, yet can be removed and reconnected any number of times without solder or special tools. These terminals are supplied on reels in continuous strip. Customer crimps them on wires using AMP automatic machines at speeds up to 4,000 per hour!

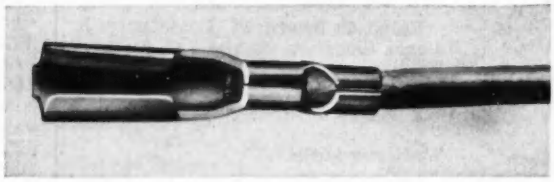
Performance of these miniature connectors meets exacting requirements for millivolt drop, corrosion resistance, and vibration. They are suited for critical low level circuits or power circuits up to several amperes.

Write to AMP Electronics Division for complete information concerning AMP TAPER TAB RECEPTACLES . . . you will receive data and samples by return mail.

An example of the savings possible with Taper Tabs and Receptacles. This disconnect block in Remington Rand's new electronic computer had more than 1,000 wires soldered to tabs in a space approximately 5" x 9"—an assembly operation requiring two weeks' time. After tabs were modified to taper shape (See picture insert), the same operator can now assemble two blocks per day—a 20 to 1 increase—using A-MP's Taper Tab Receptacle No. 41355. There are neither loose wire ends nor drops of solder in the assembly to cause shorts nor cold or rosin joints to open up in the field. Installation is simply a mechanical operation requiring little operator skill, resulting in greater uniformity.

*For connector plugs and other applications where a round pin is more adaptable, see AMP taper pins.

PHOTO AT RIGHT SHOWS AMP SELF LOCKING TAPER TAB RECEPTACLES BEING APPLIED TO MATING TABS ON A STEPPING SWITCH. LOCKING ACTION GIVES MAXIMUM ELECTRICAL AND MECHANICAL SECURITY . . . CONNECTIONS ARE SUITABLE FOR CRITICAL LOW LEVEL CIRCUITS.



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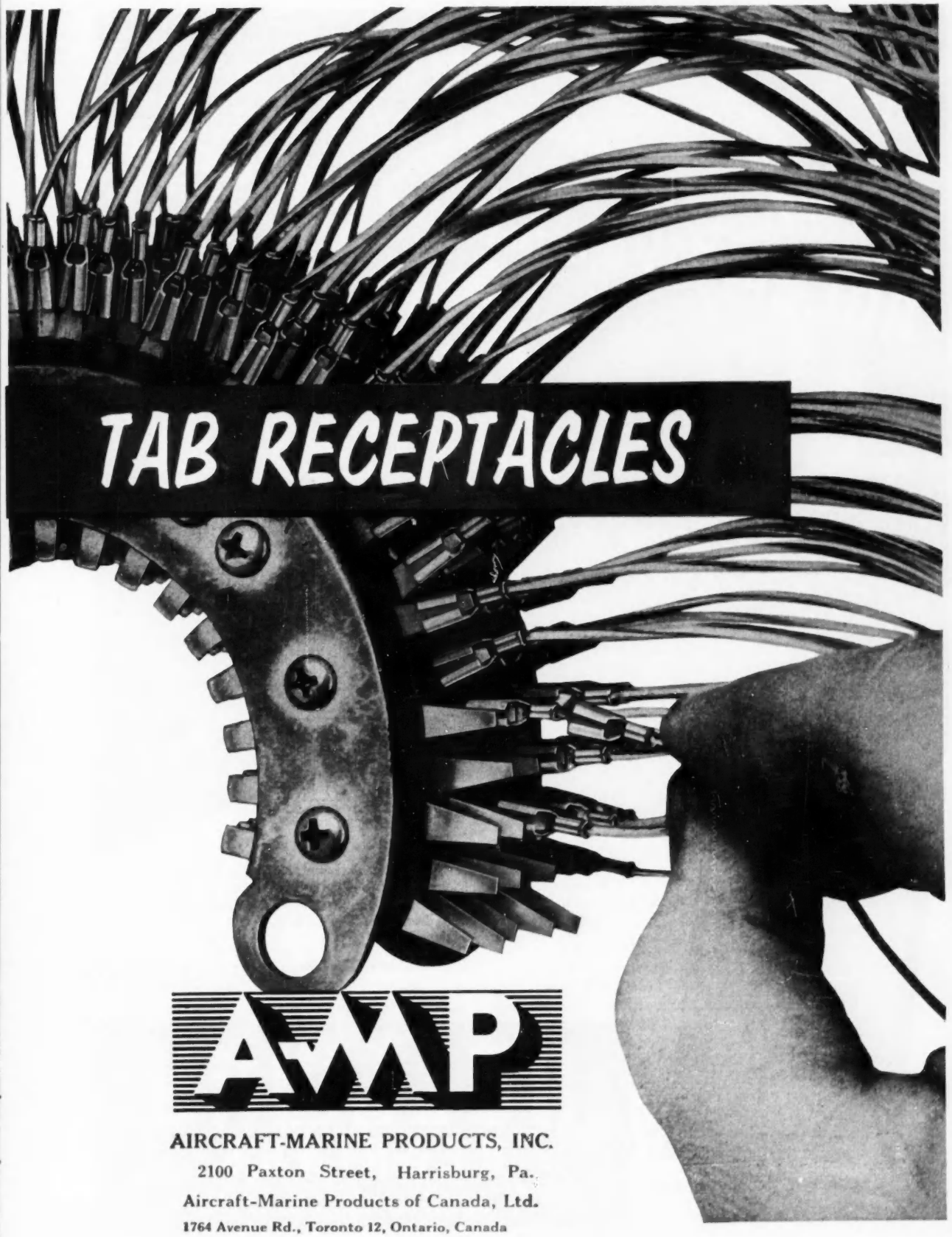
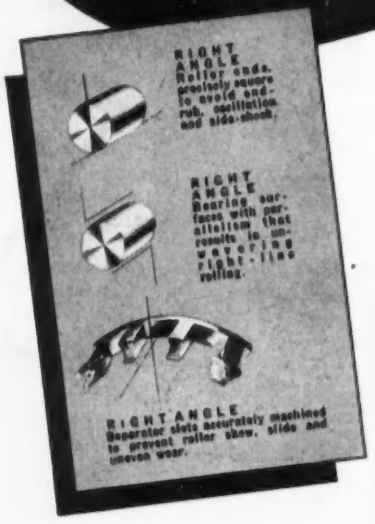


AIRCRAFT-MARINE PRODUCTS, INC.
2100 Paxton Street, Harrisburg, Pa.
Aircraft-Marine Products of Canada, Ltd.
1764 Avenue Rd., Toronto 12, Ontario, Canada

ROLLWAY Bronze-Retainer Roller Bearings

From 30" O.D. to 3" O.D.!

Regardless of size—regardless of type, radial or thrust—Rollway Roller Bearings roll right because they're made *right*. Net result of Rollway's precision "right angle design" is longer bearing service—under heavier loads—with lower maintenance cost.


RIGHT ANGLE
Roller ends precisely square to avoid end-rub, oscillation and side-shock.
RIGHT ANGLE
Bearing surfaces with parallelism that results in one-way spring right-line rolling.
RIGHT ANGLE
Separator slots accurately machined to prevent roller skew, slide and uneven wear.

• Our complete engineering and metallurgical services will gladly work with you on your problems. Simply write or wire any sales office. No cost. No obligation. Rollway Bearing Co., Inc., Syracuse 4, N. Y.

SALES OFFICES

Syracuse Cleveland Houston Boston Philadelphia Chicago
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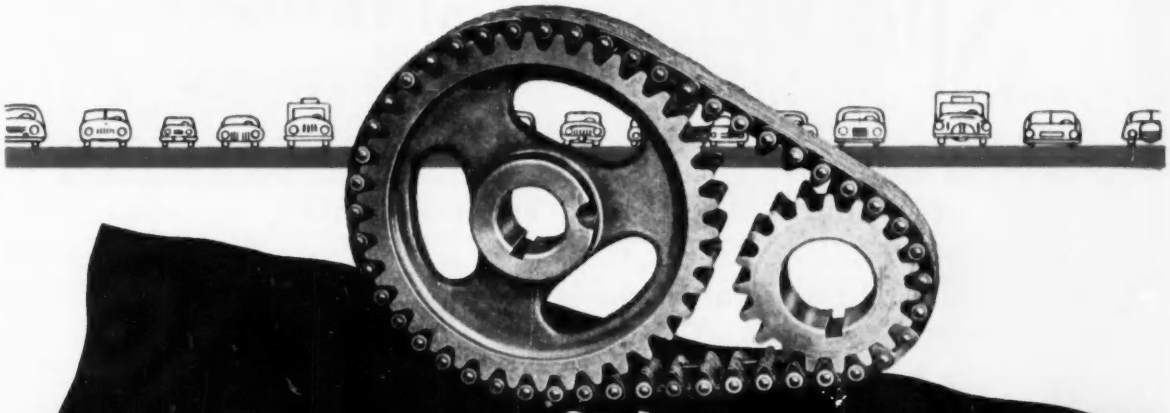
ROLLWAY® BEARINGS

Complete Line of Radial and Thrust Cylindrical Roller Bearings

Among leading automotive manufacturers

the swing's to timing chain...



and LINK-BELT Timing Chain gives you these 3 BIG advantages

Segmental bushings provide automatic joint snugness

Segmental bushings are made with slight bow.

After initial assembly in chain, bushings are straight.

Bow in bushing acts to keep a snug joint.

1. Automatic joint snugness
2. Smoother operation
3. Longer life

YES, more and more new automobile engines are being designed for timing chain. And when it comes to timing chain—no other make can match Link-Belt's outstanding advantages. What's more, the tremendous facilities of the Link-Belt plant—the world's largest chain plant—assure you a dependable source. Our engineers will supply a test drive to your specifications. For full information, ask for Book 2065. 13,344

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TIMING CHAINS and SPROCKETS

LINK-BELT COMPANY: 220 South Belmont Ave., Indianapolis 6, Ind. Offices in principal cities.

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FIRST CHOICE OF AUTOMOTIVE ENGINEERS

Auto and Truck Horns (air and electric)

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Self-cancelling Switches for Directional Signals

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Makers of Quality Automotive Equipment Since 1900

Sparton
AUTOMOTIVE
Division of
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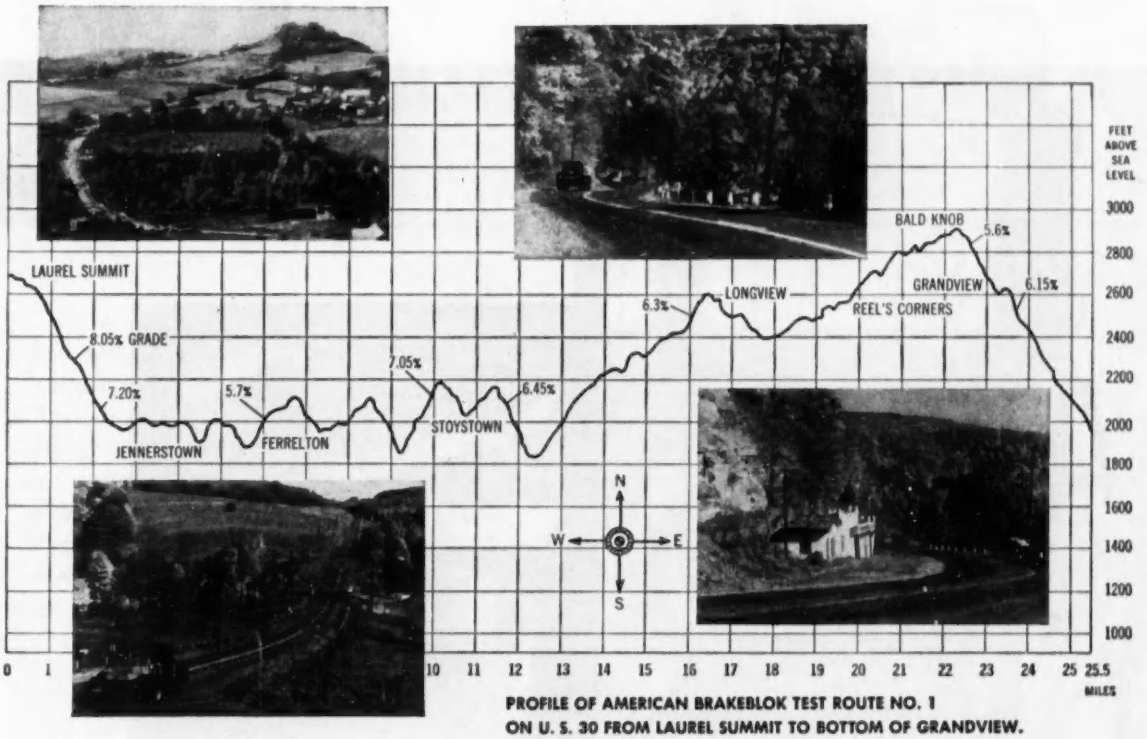
TORTURE TRACK *25.5 MILES LONG!*



PROFILE OF AMERICAN BRAKEBLOK TEST ROUTE NO. 1
ON U. S. 30 FROM LAUREL SUMMIT TO BOTTOM OF GRANDVIEW.

. . . to develop the best brake lining for you

American Brakeblok Test Trucks follow this course daily. Under all conditions of load the lining is put through every possible test—performance, fade, recovery, moisture sensitivity, wear, glaze, and maximum heat resistance. Accurate instrumentation records test data for interpretation by our research staff.

The mountains of Pennsylvania were selected because of their sharp grades, long descents, hairpin curves and dangerous intersections, giving the best opportunity for testing brake lining through a wide range of operating conditions.

On this track . . . today's brake linings are perfected—tomorrow's proven . . . for maximum safety, performance and life.

American Brakeblok

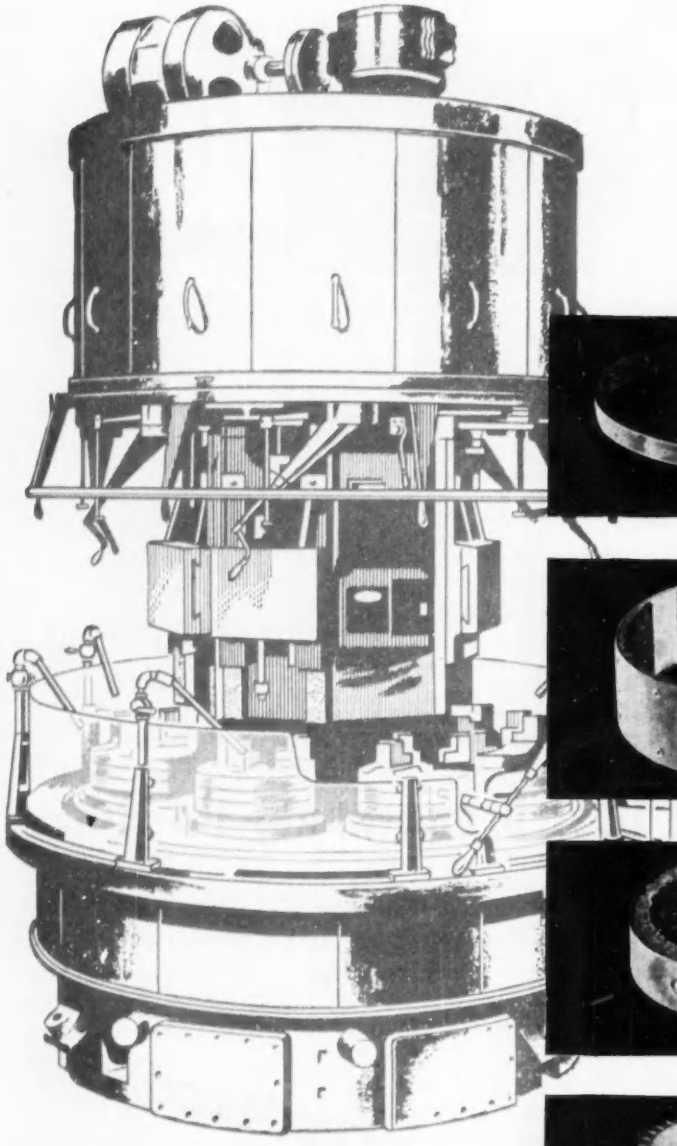
THE SAFETY BRAKE LINING

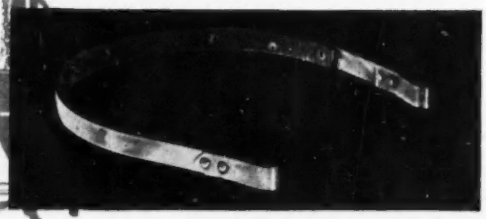
Copyright 1953, American Brake Shoe Company

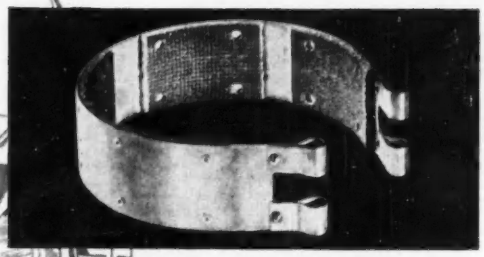
AMERICAN Brake Shoe COMPANY

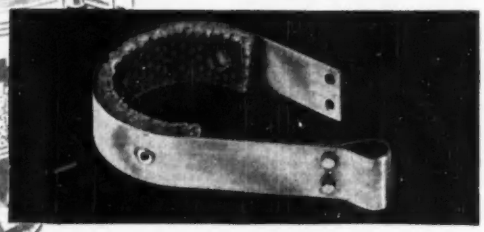
AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN
Plants in: Detroit, Michigan; Winchester, Virginia; Lindsay, Ontario; Gif, France

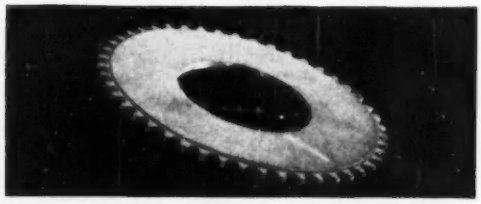
R/M
FIRST IN FRICTION

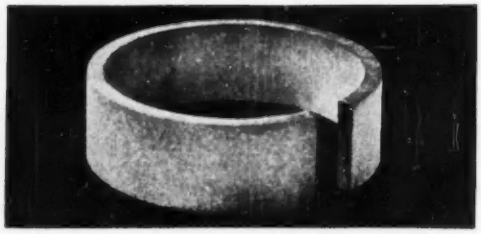










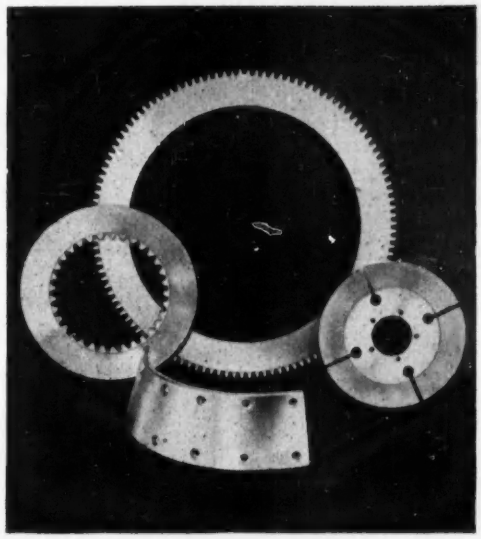


This multi-spindle vertical chucking lathe requires three entirely different types of friction materials for three completely different applications. R/M supplies all three, in five part numbers, saving the manufacturer the trouble of having to go to several sources to satisfy his requirements.

THE TRADE-MARK THAT SPELLS PROGRESS IN FRICTION MATERIAL DEVELOPMENT!

The story at the left typifies that of the many manufacturers who have chosen to make Raybestos-Manhattan their single source of supply for friction materials. R/M offers the distinct advantage of an exceptionally wide range of top quality products. Outstanding results are achieved because R/M works with countless combinations of different types of friction materials . . . including woven and molded asbestos, semi-metallic materials, and sintered metal parts.

If you are making or designing a product which requires friction materials, talk to your R/M representative. You will find he can work from samples, from designs on paper, from figures on horsepower developed combined with the desired performance characteristics. Behind him stand all the facilities of the world's largest maker of friction materials.



There's an increasing need for sintered metal parts. This is particularly true where applications call for close tolerances or operating conditions require immersion in oil. R/M is producing these parts as fast as industry needs them.

Write for your copy of the R/M Engineering Bulletin. It describes and illustrates many R/M friction materials for aviation, agriculture, the automotive industry and others.

RAYBESTOS-MANHATTAN, INC.

EQUIPMENT SALES DIVISION 6010 Northwest Highway, Chicago 31, Ill.

Detroit 2 Cleveland 14 Los Angeles 58

Factories: Bridgeport, Conn. Manheim, Pa. Passaic, N.J. No. Charleston, S.C.

Crawfordsville, Ind. Neenah, Wis. Canadian Raybestos Co. Ltd., Peterborough, Ont.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Brake Linings • Brake Blocks • Clutch Facings Fan Belts • Radiator Hose • Industrial Rubber Products • Rubber Covered Equipment • Packings • Teflon Products • Asbestos Textiles • Sintered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

R M

FIRST IN FRICTION

performance proven *by millions of installations*

- ***"No Kick-Out" feature wins overwhelming approval from car, truck and tractor manufacturers***

Although a comparatively new advancement in starter drive design, the Bendix* Folo-Thru Drive has already proven itself in millions of installations to be the most efficient starting equipment under all operating conditions.

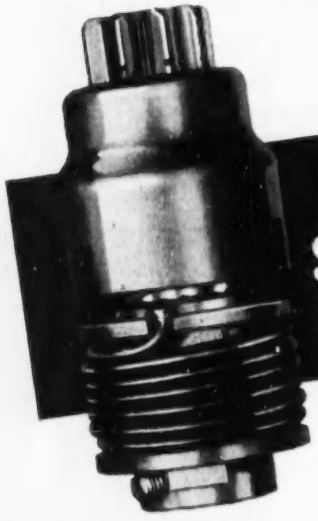
The Folo-Thru type is specially designed to follow thru the weak explosions until the engine actually runs on its own power. Thus, quicker and more dependable starts are assured even under the most extreme weather conditions.

You're right from the start when you specify Bendix Folo-Thru Starter Drive.

ECLIPSE MACHINE DIVISION OF Bendix
AVIATION CORPORATION
ELMIRA, NEW YORK

Export Sales: Bendix International Division, 205 East 42nd Street, New York 17, N. Y.

Bendix folo-thru starter drive



costs less—*Like the millions of Bendix Starter Drives manufactured for the industry, the new Folo-Thru Drive requires no actuating linkage, and the less expensive solenoid may be placed in any convenient position. Result is lower installation and maintenance costs. Complete detailed information is available on request.*

*REG. U.S. PAT. OFF.

Bendix* Folo-Thru Starter Drive Bendix* Automotive Electric Fuel Pump Stromberg* Aeroquad Carburetor

1903 1953
FIRST FIFTY YEARS
CLARK EQUIPMENT

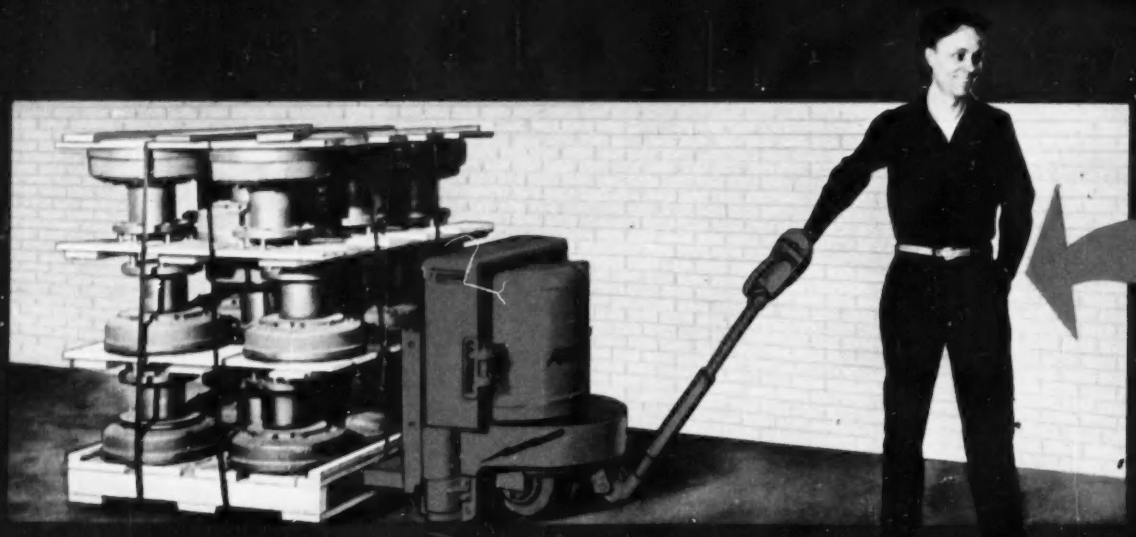
CLARK

One way to make sure that a truck, bus or farm tractor has a reserve of dependability is to equip it with a Clark transmission. This has been true for a quarter-century — and it's well worth thorough consideration when your plans involve power transmission problems. It's good business to work with Clark.

Turn and see reverse side for more about CLARK products

CLARK EQUIPMENT COMPANY, Buchanan, Michigan

Other Plants: BATTLE CREEK AND JACKSON, MICHIGAN



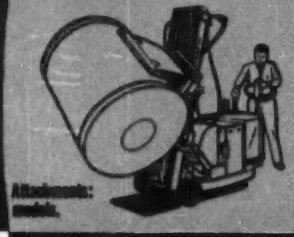
Handle a Three-ton Load with One Hand in Your Pocket

Use CLARK POWRWORKERS!

CAN'T YOU JUST PICTURE THIS MAN trying to pull this load with an old-fashioned manual hand truck! It's a cinch he wouldn't have a smile on his face—there'd be sweat and strain, because those transmission housings weigh pretty near three tons!

As a matter of fact, his boss is even happier. That POWRWORKER pallet truck has taken the muscle work out of the job, turned a tired worker into the smiling chap you see here. Furthermore, this employee is now doing twice the work he accomplished manually. No labor problem here! And the boss gets more effective use of his storage space, because the compact little POWRWORKER thrives on narrow aisles and low-load floors.

Not to mention the fact that the POWRWORKER is tailor-made for tight budgets. Big-truck benefits at small-truck cost—which means that nobody need deny himself the money-saving advantages of mechanized handling. Pound for pound, dollar for dollar, you can't beat the value in CLARK'S POWRWORKER Line.



Get the facts from your nearby CLARK Dealer—look under "Trucks Industrial," in the Yellow Pages of your phone book; or write for POWRWORKER literature, to Clark Equipment Company, Industrial Truck Division, Battle Creek, Michigan.

1903 1953 CLARK EQUIPMENT

CLARK EQUIPMENT *Products*—TRANSMISSIONS • AXLE HOUSINGS • TRACTOR UNITS • FORK TRUCKS and TOWING TRACTORS • ROSS CARRIERS POWRWORKER HAND TRUCKS • POWER SHOVELS • ELECTRIC STEEL CASTINGS GEARS and FORGINGS • FRONT and REAR AXLES for TRUCKS and BUSES

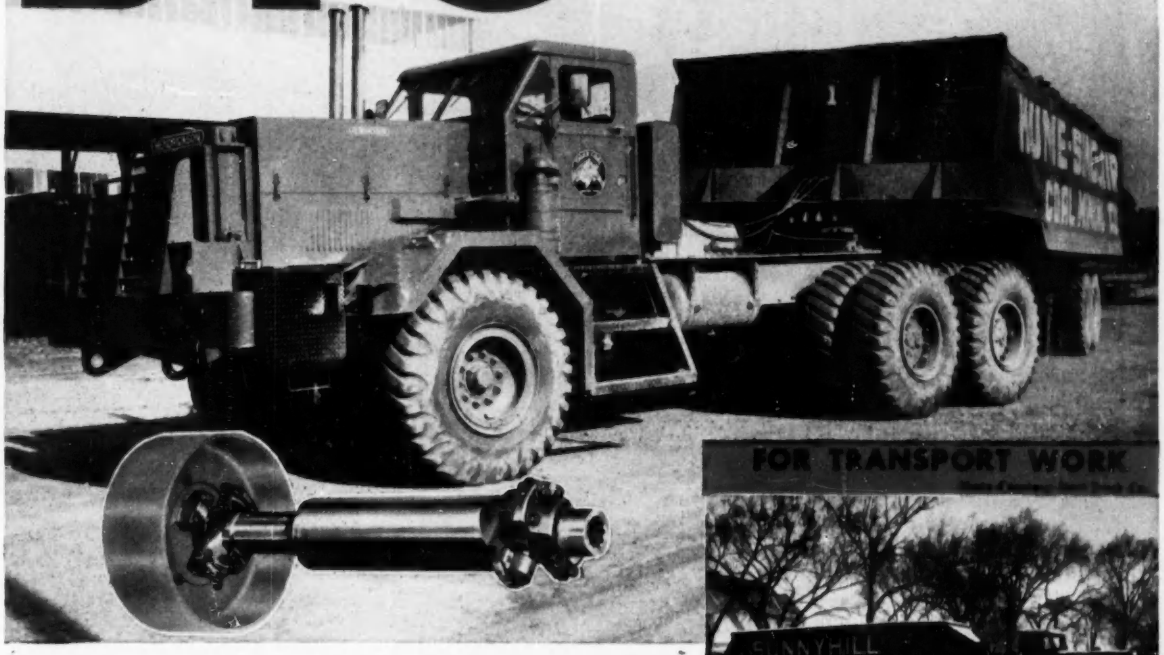
CLARK EQUIPMENT COMPANY • BUCHANAN, MICHIGAN

OTHER PLANTS: BENTON HARBOR • BATTLE CREEK *and* JACKSON, MICHIGAN

BIG

FOR MINE HAULING

Jobs Can't Afford to Be Kept Idle by Needless Down-Time



FOR TRANSPORT WORK

FOR TRACTOR TOWING

FOR OFF-HIGHWAY JOBS

Why Not Give YOUR Truck MECHANICS Advantages?

MECHANICS Roller Bearing UNIVERSAL JOINTS will give *your* trucks *more road time* and *less shop time* because MECHANICS JOINTS are specially designed with less parts and connections — for *easy assembly* and *servicing* — *smooth running balance* — *maximum strength* with *less weight* — and *long, trouble-free, safe operation.* Either the joints or brake drum can be serviced independently without disturbing other attachments or altering original drum or propeller shaft balance. Let MECHANICS engineers give *your* trucks or other heavy-duty machines these competitive advantages.

MECHANICS
UNIVERSAL JOINT
DIVISION
Borg-Warner
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Rockford, Ill.

MECHANICS
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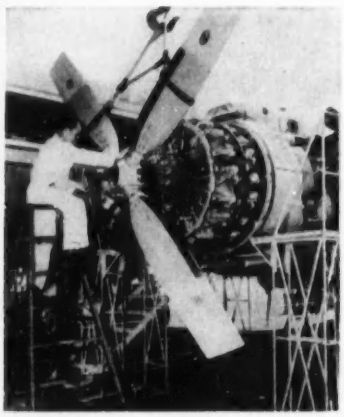
UNIVERSAL JOINTS
For Cars • Trucks • Tractors • Farm Implements • Road Machinery • Aircraft • Tanks • Busses and Industrial Equipment

LORD Dynafocal Engine Mountings

ON THE NEW DC 7

DOUGLAS



Safety . . . Speed . . . Comfort characterize the new Douglas DC 7, "the world's fastest piston-powered commercial airliner". Contributing to these factors, Lord MR43 Dynafocal Engine Mountings and Bonded-Rubber parts control vibration throughout the aircraft.

Lord Bonded-Rubber parts will help to protect your product from the damaging effects of vibration and shock . . . improve its performance. We invite you to make good use of our experience.

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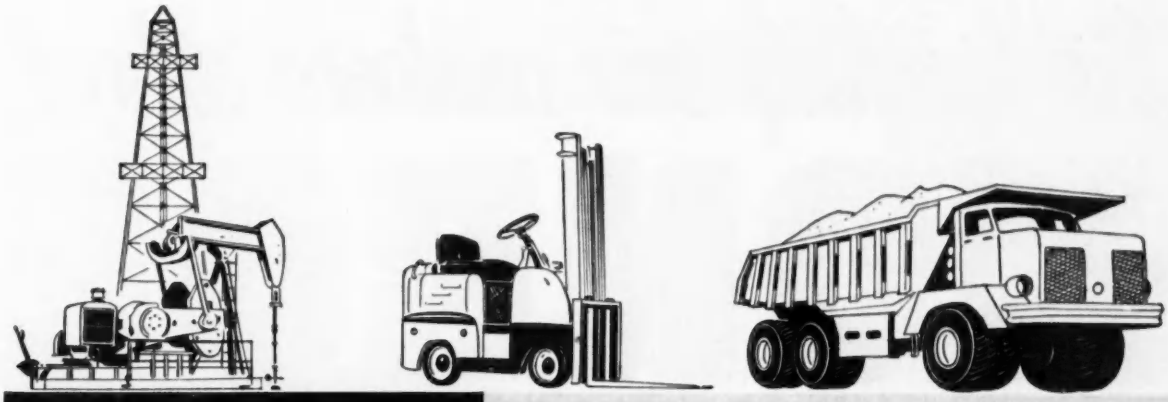
LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for
VIBRATION CONTROL



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THAT RELIES ON

THOMPSON VALVES

Buda engines power the world's largest dump truck... a twin-engine giant that can haul 60 tons of copper ore per load.

Buda engines also power oil-well rigs and concrete pavers... lift-trucks and generator sets.

Buda engines have a reputation for dependable, economical operation in all types of service. *Thompson supplies the valves.*

Take a tip from Buda... and other leading engine builders... count on Thompson's leadership in valve design and production.

VALVE DIVISION

Thompson Products, Inc.

DEPT. VS-12 • CLEVELAND 17, OHIO

Six leading car makers adopt

MONROE POWER-GUIDE

INDUSTRY'S TOP ENGINEERS PROVE MONROE'S NEW POWER STEERING

★ *Now optional on six makes of cars!*

Six leading car makers, after thorough study and exhaustive tests, have adopted Monroe Power-Guide for optional factory equipment. This endorsement of Monroe Power-Guide by the industry's leading engineers is your assurance of quality and satisfaction. For the surest, safest, simplest power steering yet devised, select Monroe Power-Guide — built by Monroe, builders of over 50,000,000 hydraulic units for the automotive industry.

★ *The only Power Steering unit dealers can install!*

Monroe's Direct Action Hydraulic Power-Guide is the first practical power steering unit for installation by car dealer or service garage. Valve and cylinder are contained in one compact unit, the simplest device yet developed for taking the work out of steering. Surest, safest, simplest, Monroe Power-Guide is the outstanding development in power steering.

AVAILABLE NOW

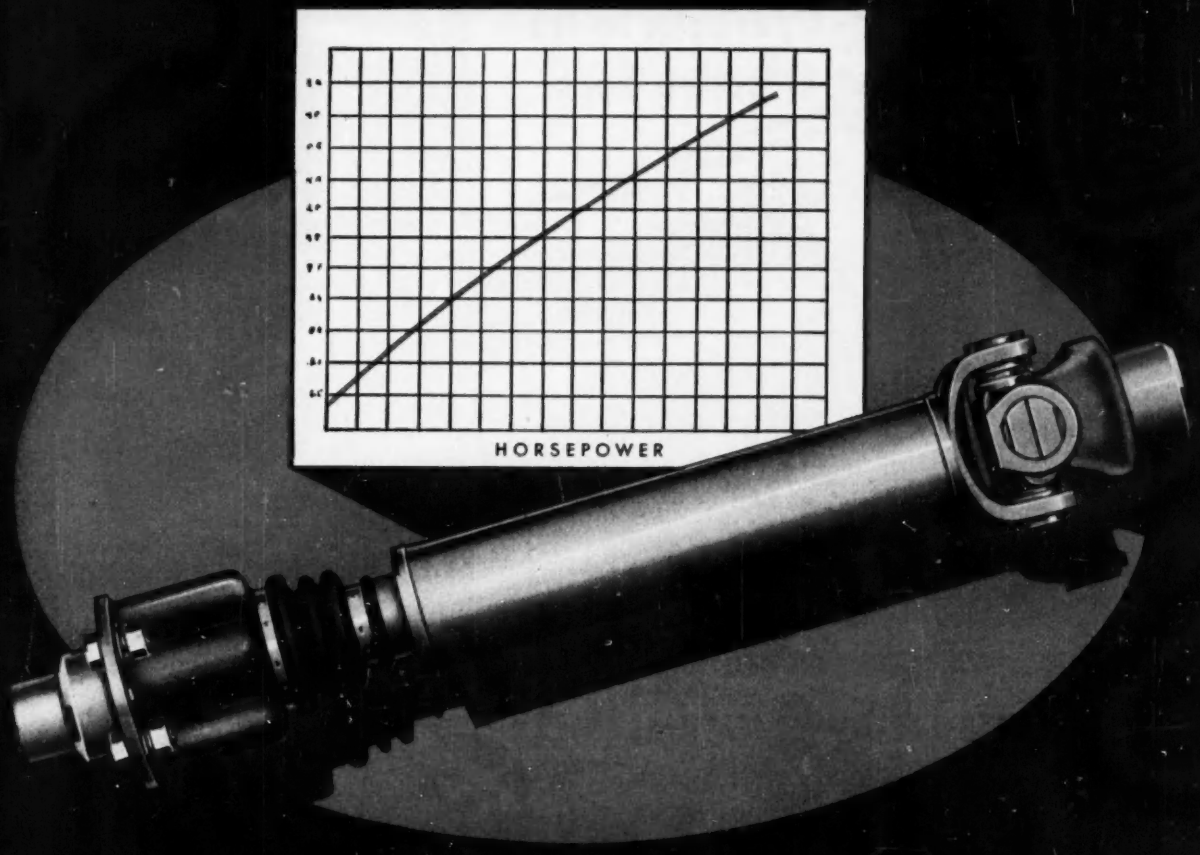
Monroe Power-Guide is now available for 1952-53 Fords, 1952-'53 Mercurys, and for 1950-'53 Cadillacs. Units for other makes and models will be available soon.

MONROE AUTO EQUIPMENT CO.

Monroe, Michigan

World's Largest Maker of Ride Control Products

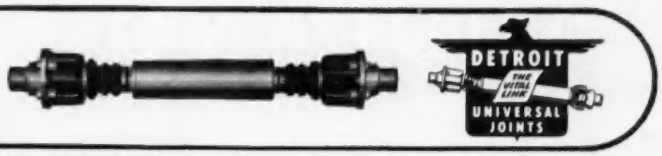
Today's Competition for Horsepower...



...Puts Universal Joints on the Spot

Car engineers are doing a great job of stepping up the horsepower of today's engines. But every bit of new power puts added strain on universal joints. That's why the extra quality built into "DETROIT" Universal Joints is so important—they're built for today's high torque engines.

DETROIT
UNIVERSAL JOINTS



UNIVERSAL PRODUCTS COMPANY, Inc., Dearborn, Michigan

MIDLAND

with Air-Over-Hydraulic In Its Simplest, Most Effective Form

WAS FIRST

MIDLAND

AIR HY-POWER

CHECK THESE EXCLUSIVE FEATURES

Extra Safety–The air brake system with added safety feature of hydraulic brake operation in reserve in case of inadequate air pressure.

Directly Applied Power—Quicker, safer stops with less driver effort.

Better Control—Brake pedal "feel" permits driver to apply quick, effective brake action.

Dependable Operation–Sealed protection from water, dirt and corrosion.

Lower Cost—Saves installation time and money because of fewer parts and more compact simpler design.

THE MIDLAND STEEL PRODUCTS COMPANY

3641 E. MILWAUKEE AVE. DETROIT 11, MICH.

Export Department: 38 Pearl St., New York, N. Y.

Those Who Know Power Brakes
CHOOSE MIDLAND

Because . . .

Midland builds a full line of Air and Vacuum Power Brake Equipment for every highway need.

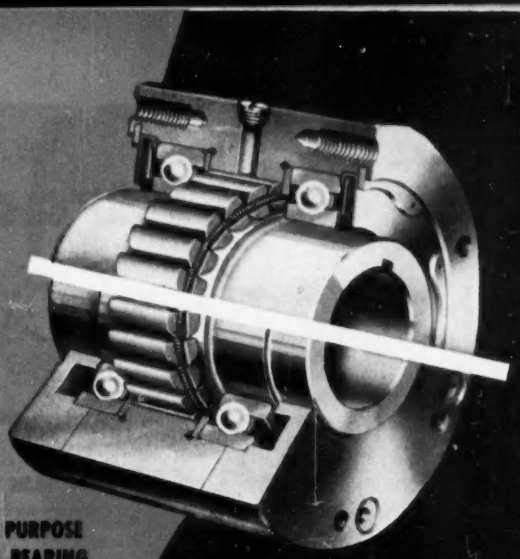
Each Midland Power Brake Kit is especially engineered for a specific tractor, truck, trailer or bus.

Each working part is tested to make sure it is up to Midland's high standards of quality.

Available factory-installed by leading truck manufacturers and through Midland Distributors.

GO MIDLAND — AND STOP SAFELY!

Everything You've Ever Wanted From a Clutch!

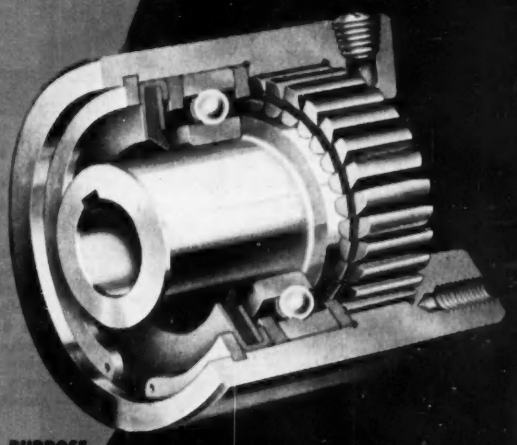


ALL PURPOSE BALL BEARING

FULL COMPLEMENT

FORMSPRAG Clutches

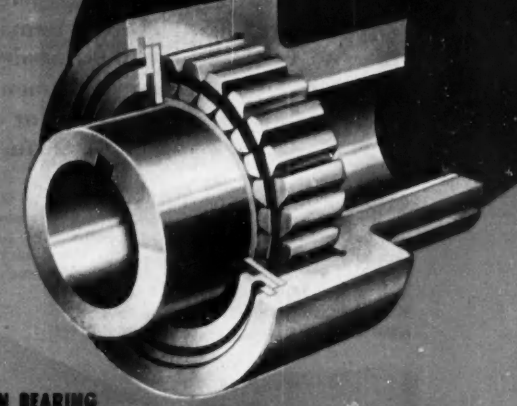
OVER-RUNNING · BACKSTOPPING · INDEXING



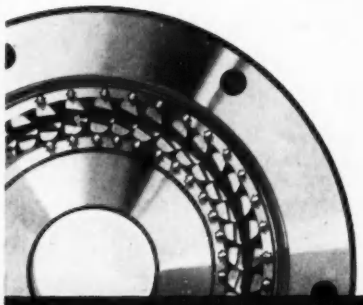
TELL US ABOUT *YOUR* APPLICATION
Should it be as small as this one for a duplicating machine . . .

or as large as this one for an oil well rig—you'll want THE CLUTCH THAT DELIVERS THE GREATEST TORQUE CAPACITY FOR ITS SIZE AND WEIGHT —*THAT'S FORMSPRAG.*

SPECIAL PURPOSE BALL BEARING



PLAIN BEARING



The infinite number of gripping positions available through sprag action makes possible this and other exclusive performance features like instantaneous operation with no backlash; internal simplicity; long life.

Let Formsprag know today the performance you expect, the shaft size, the capacity, etc. If you don't have information on Formsprag clutches, send for it today with the coupon at right.

DISTRIBUTORS IN PRINCIPAL CITIES

Your inquiries about Bolmsprag and Cagedsprag Over-Running Clutches are welcomed by the Formsprag Company.

FORMSPRAG COMPANY
23581 Hoover Road, Van Dyke, Mich.

Send the Formsprag Folder to:

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

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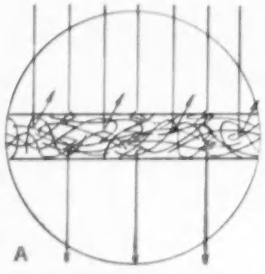
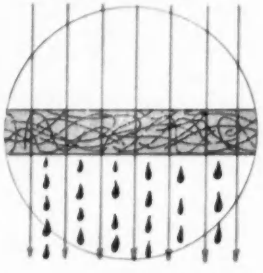
How tracing paper is made and why ALBANENE* is Different

TOUGH, LONG-FIBER PAPER
NOT TRANSPARENTIZED



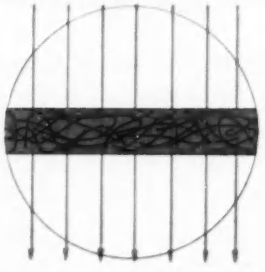
Diagrammatic enlargement of cross section of paper with high strength but low transparency. Fibers are surrounded by air, which has different index of refraction. Many light rays are bent back and do not get through.

SAME PAPER
TRANSPARENTIZED WITH FLUID MATERIAL



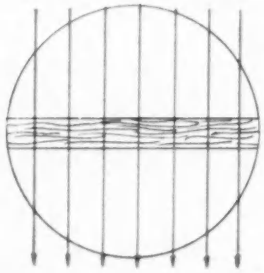
Same paper as "A", filled with oil or other fluid material, giving spaces between fibers same index of refraction as fibers. Reflection and refraction of light are reduced and paper becomes highly transparent. But transparency is not permanent because *fluids* "bleed" out.†

SAME PAPER
TRANSPARENTIZED THE ALBANENE WAY



Same paper as "A", filled with an inert synthetic resin, with correct index of refraction. This is how Albanene is made. Its transparentizer does not "bleed" out. Albanene holds its color and strength and is permanently transparent.†

PAPER TRANSPARENTIZED BY
CRUSHING AND BEATING FIBERS



Papers are also transparentized at the mill by a "beating" process. The fibers are crushed, flattened and compacted. Reflection and refraction of light are reduced. But the process weakens the fibers and the strength of the transparent paper is low.

More than 15 tests are made during production of Albanene. For example, each production roll is tested for pencil "take", for pencil erasing and the taking of drawing ink. To eliminate human variables, pencil lines are drawn by machine. In this way you are assured of the uniformity of working surface so much desired by draftsmen, and assured of a paper that makes cleaner, sharper prints . . . now or a generation later. Ask your K&E Distributor or Branch for further information.

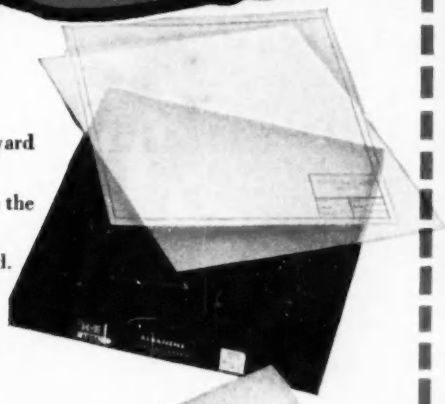
† Prove this by making the "drafting tape test" Press a short piece of drafting tape on fluid-transparentized paper, and another on Albanene. Strip them off the next day and examine both papers. Notice that enough fluid has drifted out of the ordinary paper into the tape to destroy much of the transparency. And notice that Albanene is not affected. What drafting tape does over night, time will do naturally.

*TRADE MARKS ®

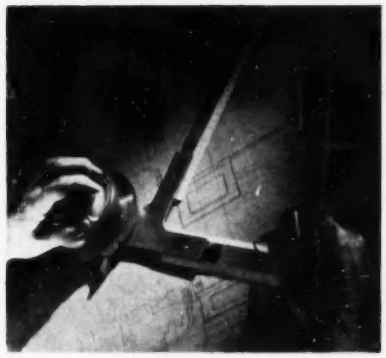
Transparent... and Better!

AVAILABLE IN MANY FORMS FOR MANY USES

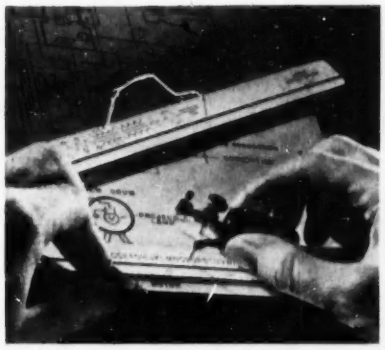
Albanene comes in 20-yard and 50-yard rolls in various widths and in three different weights. For those who like the convenience of cut sheets, a new Albanene package has been designed. It strongly protects the paper in shipment and storage, and may be opened without mutilating the container, thus serves as a dispenser in drafting room or stock room. Albanene cut sheets can be supplied imprinted to your specifications.



The Right Angle



Once you've discovered the pleasure of drawing on Albanene, the next logical step is to save time, trouble and eyesight with a K&E PARAGON* Drafting Machine. You control your calibrated straight edge with a light touch of one hand, for parallel lines and lines at any angle.



Make your lettering letter-perfect and save wear and tear on your nerves by using a LEROY* lettering outfit. Template grooves guide your pen so the finished result looks like printers' type, and the whole process is relaxing. There's a wide choice of sizes, styles and symbols.

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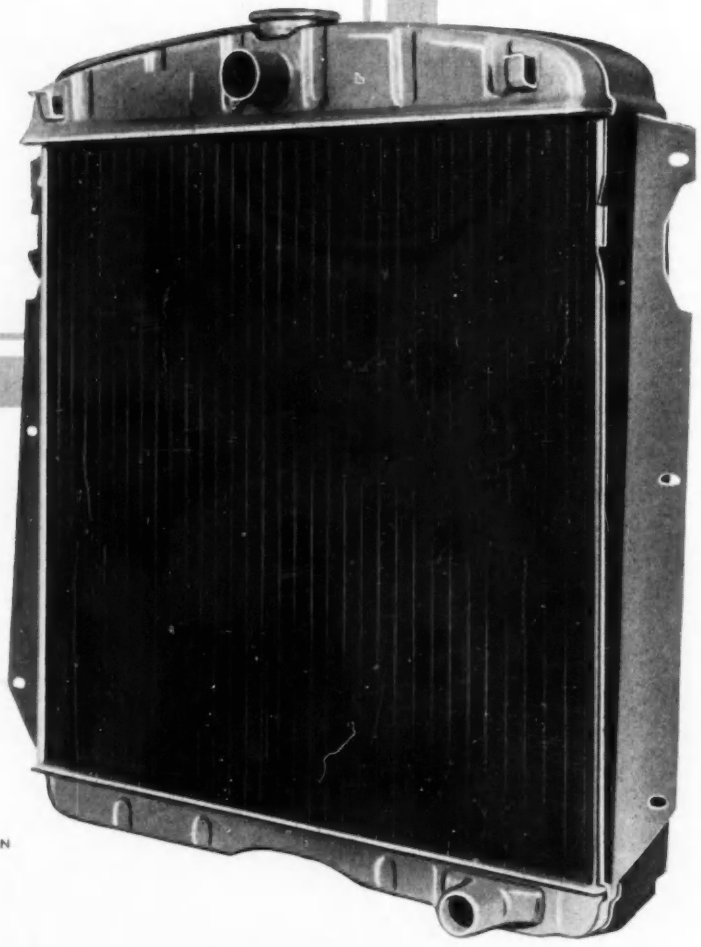
Dependable cooling from a dependable source



HARRISON
RADIATOR
DIVISION

GENERAL MOTORS CORPORATION
LOCKPORT, NEW YORK

HARRISON

Fishtail...

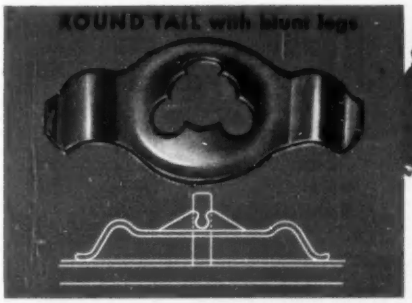
New anti-rattle fastener for NAMEPLATES and trim holds threadless studs

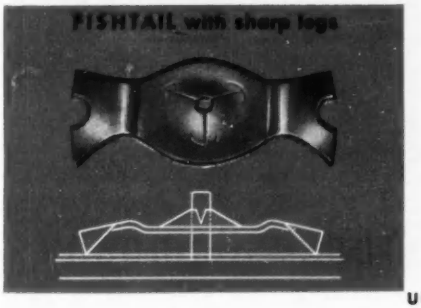
Quick, tight, permanent fastening for name-plates and other die-cast trim is now possible without nuts and washers, thanks to United-Carr's Fishtail fastener.

Easily attached with simple hand tools, its teeth actually bite into chrome-finished, threadless studs so that there is no chance of slippage or looseness.

Fishtail's grip on welded, staked or extruded studs is independent of the pressure of the spring take-up legs. Leg pressure, however, allows positioning adjustments while it provides secure anchorage even when the studs protrude through oversize holes.

Fishtail fasteners can be used on flat or contoured surfaces and their cup-shaped centers hold and retain sealing compounds.





Like thousands of other fasteners and allied devices, designed and manufactured by United-Carr, Fishtail fasteners help speed assembly and cut costs. Available in a complete range of sizes and in volume quantities; further details on request.

UNITED-CARR

MAKERS OF DOT FASTENERS

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

6

Our modern plants

in six separate locations

give you a stabilized, dependable

source for sleeve bearings

and bushings—

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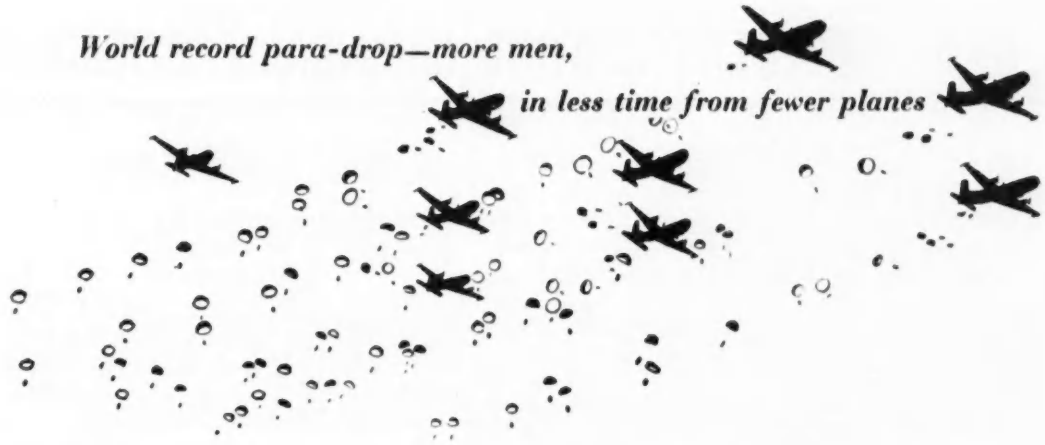
The Cleveland Graphite Bronze Company

DIVISION OF CLEVITE CORPORATION

World record para-drop—more men,

in less time from fewer planes



with the—Douglas C-124 Globemaster

Nine Douglas C-124 Globemasters of the 18th Air Force, 62nd Group, 7th Squadron, cruised above Fort Bragg. Seconds later, more than a thousand paratroopers had hit the silk... were floating down on the drop zone.

For this record-breaking drop, Globemaster—the Air Force's largest operational transport plane—was a logical choice. Clamshell doors, located in the nose, make loading of troops or matériel fast and easy. Load space is two stories high... gross weight at take-off, 87½ tons. A single Globemaster can transport 200 armed troops across the Atlantic—deliver 25-ton loads of tanks, cranes, loaded trucks to fill immediate needs at bases anywhere in the world.

Performance of the C-124 Globemaster is another example of Douglas leadership in aviation. Planes that can be produced in quantity to fly *faster and farther with a bigger payload* is a basic rule of Douglas design.

Enlist to fly in the U. S. Air Force

Depend on *DOUGLAS* **First in Aviation**

NEW PROTECTIVE COATING CHEMICAL FOR ALUMINUM

ALODIZING

Alodizing with "Alodine,"* a new technique in the protective coating of aluminum, was made available for production-scale use in 1946. Since that time Alodizing has largely supplanted the more elaborate, costly and time-consuming anodic treatments in the aircraft and other industries.

Continuous and successful industrial use has clearly demonstrated the simplicity and economy of the Alodizing process as well as the effectiveness of the "Alodine" amorphous coatings, particularly as a base for paint. In fact, the paint-bond that Alodized aluminum provides has been found to be superior to that possible with chromic acid anodizing.

The corrosion-resistance of unpainted aluminum Alodized with "Alodine" Nos. 100 or 300 is excellent, easily meeting the requirements of Specification MIL-C-5541. However, a need for protection of unpainted aluminum, even better than that obtained with chromic acid anodizing, has long been recognized.

NEW IMPROVED "ALODINE" DEVELOPED By ACP RESEARCH CHEMISTS

Several years of intensive research have now led to a new type of "Alodine," designated as "Alodine" No. 1200. This new protective coating chemical forms an amorphous mixed metallic oxide coating of low dielectric resistance that provides unusually high corrosion-resistance for unpainted aluminum. In addition, it forms an excellent paint bond that approaches closely the high quality obtained with the earlier types of "Alodine."

After having been tested for conformance with Specification MIL-C-5541, "Alodine" No. 1200 is now about to go into production.

PROCESS DETAILS

"Alodine" No. 1200 is the only essential chemical needed to prepare the coating bath and the final rinse bath. One of its unique features is that it can be used in tanks in an immersion process, or, in a multi-stage power washer in a spray process, or, with a slight adjustment of pH, with brush or portable spray equipment in a manual process. This means that even where the simple production equipment is not available, or where touching up of damaged coatings previously Alodized or anodized is required, excellent protection and paint bonding can still be obtained with practically no equipment.

*"Alodine" Trade Mark Reg. U. S. Pat. Off.

All three methods of application easily meet the requirements of Specification MIL-C-5541.

Process sequence for all three methods of application is the same as for other standard grades of "Alodine" such as Nos. 100, 300, and 600, viz.: 1. Pre-cleaning. 2. Rinsing. 3. Alodizing. 4. Rinsing. 5. Acidulated rinsing. 6. Drying.

Coating time in an immersion process ranges from 2 to 8 minutes and in a mechanized spray process is about 30 seconds. "Alodine" No. 1200 baths are operated at room temperatures (70° to 100°F.) and heating is required only if the bath has gotten cold after a "down" period.

RECOMMENDED USES FOR "ALODINE" No. 1200

"Alodine" No. 1200 is specifically recommended for coating wrought products that are not to be painted or are to be only partially painted; and for coating casting and forging alloys whether or not these are to be painted. "Alodine" Nos. 100 and 300 are still recommended for coating wrought products such as venetian blind slats, awnings, etc., that are invariably painted.

RESULTS OF TENSILE TESTS

This new "Alodine" not only retards visible corrosion and pitting, but as shown in the table below, the loss of ductility with "Alodine" No. 1200, both brush and dip, after 1000 hours salt spray was less than for chromic acid anodizing after 250 hours, and for "Alodine" No. 100 and a conventional chromate treatment after 168 hours exposure.

PROCESS	SALT SPRAY EXPOSURE	COMPLIANCE WITH TENSILE REQUIREMENTS OF MIL-C-5541
CHROMIC ACID ANODIZING	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	fails
	1000 hrs.	fails
BRUSH "ALODINE" No. 1200	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	passes
	1000 hrs.	passes
DIP "ALODINE" No. 1200	168 hrs.	passes
	250 hrs.	passes
	500 hrs.	passes
	1000 hrs.	passes
DIP "ALODINE" No. 100	168 hrs.	passes
	250 hrs.	fails
	500 hrs.	fails
	1000 hrs.	fails
CONVENTIONAL CHROMATE TREATMENT	168 hrs.	passes
	250 hrs.	fails
	500 hrs.	fails
	1000 hrs.	fails

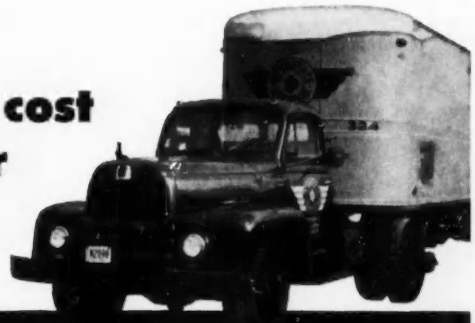
CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

General Offices: Ambler, Penna.

Detroit, Michigan **Niles, California** **Windsor, Ontario**

"Little compressor exchange cost in many years use on our vehicles equipped with Wagner Air Brakes"



says: E. "Pop" Apperley, Superintendent of Maintenance
INTERSTATE DISPATCH, INC., Chicago, Illinois

Regardless of how many miles their fleets travel, owners will be money ahead if they take the advice of men like "Pop" Apperley. Fleet operators who have installed Wagner Air Brakes have proved that they will reduce costly down time for shop repairs,are easy to install, and provide reliable, safe-sure road stopping.

The heart of all Wagner Air Brake Systems is the Wagner Rotary Air Compressor ... the compressor that maintains uniform torque load because thousands of small overlapping air compression impulses occur each minute providing smooth, dependable operation and quiet performance. There's no carbon and sludge formation in air lines either, because the oil is separated and cooled before the air is discharged from the Wagner Rotary Air Compressor. This results in the reduction of air temperature retarding the formation of carbon.

It will pay you to include Wagner Air Brakes as Standard Equipment on the vehicles you manufacture. They give truck operators added safety and economy. Write for complete information and request copy of Wagner Bulletin KU-201A.

INTERSTATE DISPATCH, INC.

Fast Motor Freight

"OVERNITE • EVERY NITE"

GENERAL OFFICES 3606 SOUTH WESTERN AVENUE, CHICAGO 9, ILLINOIS

Wagner Electric Corporation
6400 Plymouth Avenue
St. Louis 14, Missouri

October 9, 1952

Gentlemen:

Our tractor units chalk up a lot of mileage while hauling freight over the mid-west. As superintendent of maintenance for Interstate Dispatch, Inc., my main responsibility is to make sure all our road vehicles are in perfect condition before they go out. This means our drivers know the trucks they're driving are safe trucks—thoroughly checked and in top condition.

My experience with Wagner Air Brake Systems has shown that I can rely on the performance dependability of these brake units knowing that they'll provide the needed power to stop our vehicles safely, smoothly at all times. Much of this is due to the Wagner Rotary Air Compressor. It is quiet in operation, easy to install, provides ample air, and lowers our maintenance costs. In fact, I've found that Interstate Dispatch, Inc., has had little compressor exchange cost in many years use on our vehicles equipped with Wagner Air Brakes.

Very truly yours,
E. Apperley
E. APPERLEY
Superintendent of Maintenance

EA pw

TERMINALS: ST. LOUIS • INDIANAPOLIS • DAVENPORT • SPRINGFIELD • ROCK ISLAND • RICHMO... KEN • CINCINNATI

Wagner Air Brake Users are our Biggest Boosters.

Wagner Electric Corporation
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K53-5 A

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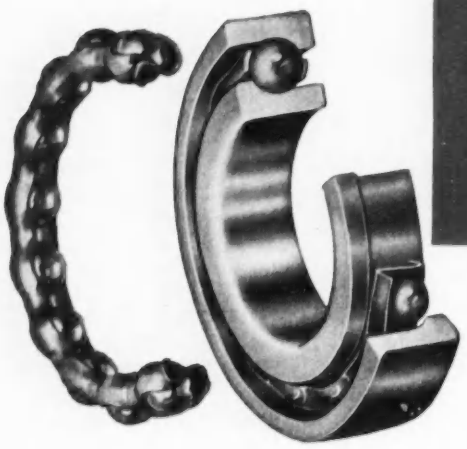


For maximum performance specify BCA ANGULAR CONTACT BEARINGS

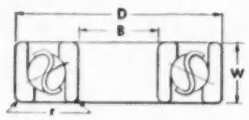
These bearings feature a sturdy one-piece, S-section retainer. There is no rivet to work loose, and the design of the retainer permits bearing construction that is fully angular-contact on both outer and inner rings. Low, medium, and high angles of contact are available in both light and medium series bearings.

BCA Angular-Contact Bearings have the ability to carry any combination of radial loads plus thrust loads in a given direction.

BCA engineering cooperation and design assistance are available to help solve your problems involving ball bearings.

The BCA Engineering Handbook is valued by engineers as an important addition to their technical library. Available to chief engineers without charge. Write on your official stationery.

DIMENSIONS AND IDENTIFICATION



Single Row—Light

Bearing Numbers Contact Angle			Bore B		Outside Diameter D		Width W		Fillet Radius* r	Balls	
Medium	Low	High	Mm.	Inches	Mm.	Inches	Mm.	Inches	Inches	No.	Size
7204-A	7204-N	7204-T	20	0.7874	47	1.8504	14	0.5512	0.040	12	1/4
7205-A	7205-N	7205-T	25	0.9843	52	2.0472	15	0.5906	0.040	11	9/32
7206-A†	7206-N†	7206-T†	30	1.1811	62	2.4409	16	0.6299	0.040	11	19/32
7207-A	7207-N	7207-T	35	1.3780	72	2.8346	17	0.6693	0.040	12	13/32
7208-A	7208-N	7208-T	40	1.5748	80	3.1496	18	0.7087	0.040	13	7/16
7209-A	7209-N	7209-T	45	1.7717	85	3.3465	19	0.7480	0.040	14	7/16
7210-A	7210-N	7210-T	50	1.9685	90	3.5433	20	0.7874	0.040	15	7/16
7211-A	7211-N	7211-T	55	2.1654	100	3.9370	21	0.8268	0.060	12	1/2
7212-A	7212-N	7212-T	60	2.3622	110	4.3307	22	0.8661	0.060	15	15/32
7213-A	7213-N	7213-T	65	2.5591	120	4.7244	23	0.9055	0.060	14	15/16
7214-A	7214-N	7214-T	70	2.7559	125	4.9213	24	0.9449	0.060	16	15/16
7215-A	7215-N	7215-T	75	2.9528	130	5.1181	25	0.9843	0.060	17	15/16
7216-A	7216-N	7216-T	80	3.1496	140	5.5118	26	1.0236	0.080	16	9/16
7217-A†	7217-N†	7217-T†	85	3.3465	150	5.9055	28	1.1024	0.080	15	13/16
7218-A	7218-N	7218-T	90	3.5433	160	6.2992	30	1.1811	0.080	15	7/8
7219-A	7219-N	7219-T	95	3.7402	170	6.6929	32	1.2598	0.080	15	15/16
7220-A	7220-N	7220-T	100	3.9370	180	7.0866	34	1.3386	0.080	15	1
7221-A	7221-N	7221-T	105	4.1339	190	7.4803	36	1.4173	0.080	15	1 1/16
7222-A	7222-N	7222-T	110	4.3307	200	7.8740	38	1.4961	0.080	15	1 1/8
7224-A	7224-N	7224-T	120	4.7244	215	8.4646	40	1.5748	0.080	15	1 3/16
7226-A	7226-N	7226-T	130	5.1181	230	9.0551	40	1.5748	0.100	16	1 1/4
7228-A	7228-N	7228-T	140	5.5118	250	9.8425	42	1.6535	0.100	16	1 5/16

Single Row—Medium

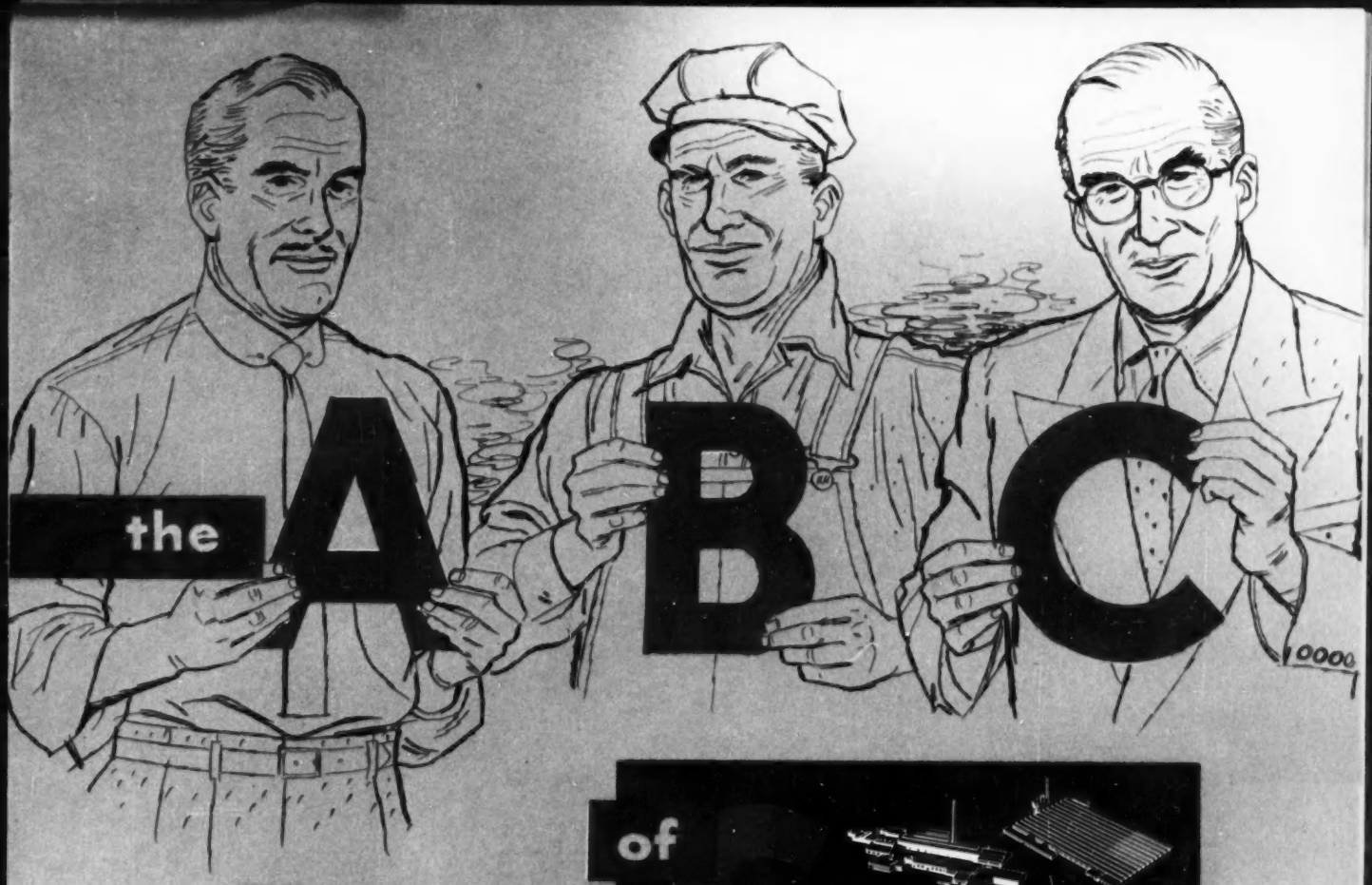
Bearing Numbers Contact Angle			Bore B		Outside Diameter D		Width W		Fillet Radius* r	Balls	
Medium	Low	High	Mm.	Inches	Mm.	Inches	Mm.	Inches	Inches	No.	Size
7303-A	7303-N	7303-T	17	0.6693	47	1.8504	14	0.5512	0.040	12	1/4
7304-A	7304-N	7304-T	20	0.7874	52	2.0472	15	0.5906	0.040	10	9/32
7305-A†	7305-N†	7305-T†	25	0.9843	62	2.4409	17	0.6693	0.040	10	7/16
7306-A	7306-N	7306-T	30	1.1811	72	2.8346	19	0.7480	0.040	10	19/32
7307-A	7307-N	7307-T	35	1.3780	80	3.1496	21	0.8268	0.060	10	17/32
7308-A	7308-N	7308-T	40	1.5748	90	3.5433	23	0.9055	0.060	10	19/32
7309-A	7309-N	7309-T	45	1.7717	100	3.9370	25	0.9843	0.060	11	11/16
7310-A	7310-N	7310-T	50	1.9685	110	4.3307	27	1.0630	0.080	12	23/32
7311-A†	7311-N†	7311-T†	55	2.1654	120	4.7244	29	1.1417	0.080	12	25/32
7312-A†	7312-N†	7312-T†	60	2.3622	130	5.1181	31	1.2205	0.080	12	7/8
7313-A†	7313-N†	7313-T†	65	2.5591	140	5.5118	33	1.2992	0.080	12	15/16
7314-A	7314-N	7314-T	70	2.7559	150	5.9055	35	1.3780	0.080	12	1
7315-A†	7315-N†	7315-T†	75	2.9528	160	6.2992	37	1.4567	0.080	12	1 1/16
7316-A†	7316-N†	7316-T†	80	3.1496	170	6.6929	39	1.5354	0.080	12	1 1/8
7317-A†	7317-N†	7317-T†	85	3.3465	180	7.0866	41	1.6142	0.100	12	1 3/16
7318-A†	7318-N†	7318-T†	90	3.5433	190	7.4803	43	1.6929	0.100	12	1 1/4
7319-A†	7319-N†	7319-T†	95	3.7402	200	7.8740	45	1.7717	0.100	12	1 5/16
7320-A†	7320-N†	7320-T†	100	3.9370	215	8.4646	47	1.8504	0.100	12	1 7/16
7321-A†	7321-N†	7321-T†	105	4.1339	225	8.8583	49	1.9291	0.100	12	1 1/2
7322-A†	7322-N†	7322-T†	110	4.3307	240	9.4488	50	1.9685	0.100	12	1 5/8

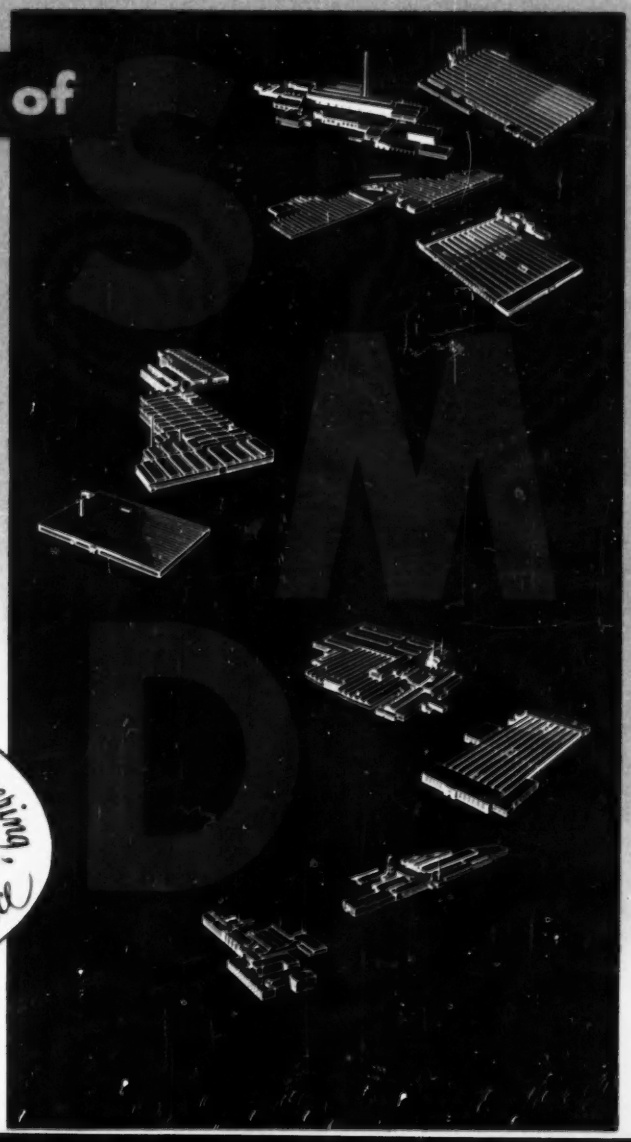
* Bearing corner radii will clear maximum fillet radius shown.
† For use of these sizes consult BCA Engineering Department.

BCA *radial, thrust, angular-contact Ball Bearings*

BEARINGS COMPANY OF AMERICA

LANCASTER • PENNSYLVANIA





Spicer Manufacturing Division is a highly specialized organization of engineering, manufacturing and executive skills in automotive power transmission.

Spicer has a record of 50 years of continuous experience in this field . . . more than any other manufacturer.

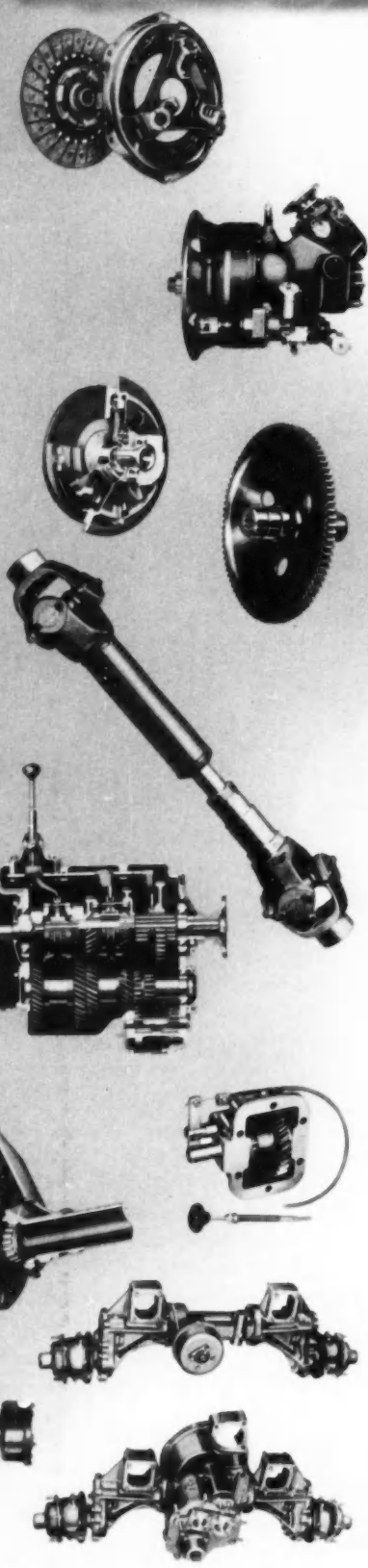
Spicer secures efficient production from 10 modern plants at its command . . . more than any other manufacturer.

Spicer has a range of proved products for almost every automotive power delivery need . . . more than any other manufacturer.

Spicer has the services you need—*use them!*

Designing, Developing, Engineering, Manufacturing and Service

Spicer



we serve the industry from A to Z

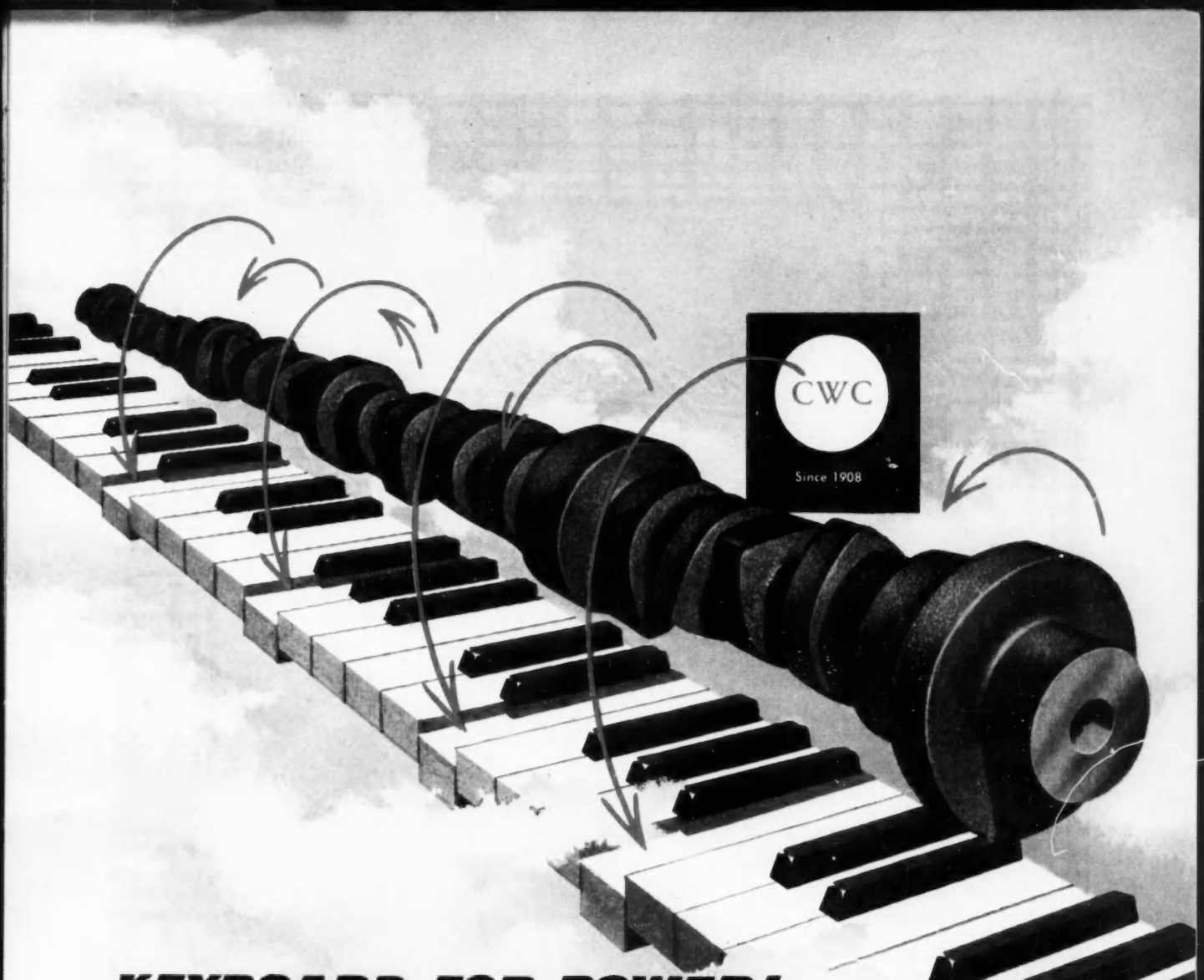
Ambition to serve . . . and zeal to produce . . . have built the famous Spicer line. We meet at the drafting board . . . we meet at the machine . . . we meet at the service conference. There is a meeting of the minds and the constructive skills on every project. Each Spicer product is a visible demonstration of that cooperation. Use Spicer engineering ingenuity and manufacturing resourcefulness to serve your needs—*better!*

SPICER MANUFACTURING DIVISION
of Dana Corporation • Toledo 1, Ohio

49 YEARS OF Spicer SERVICE

ENGINEERING DANA MANUFACTURING

TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • BROWN-LIPE AND AUBURN CLUTCHES • FORGINGS • AXLES • STAMPINGS • SPICER "BROWN-LIPE" GEAR BOXES • PARISH FRAMES • TORQUE CONVERTERS • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • WELDED TUBING



KEYBOARD FOR POWER!

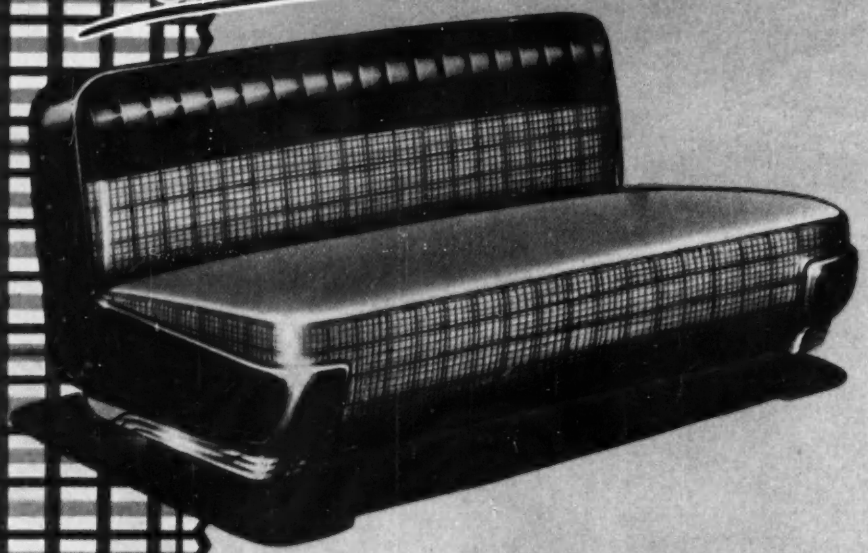
Turning at hurricane speed, the camshaft of an engine plays a powerful tune. Its finger-like cams spin in sequence, deftly controlling the explosive diet of each plunging piston. But to perform its important task, a camshaft must excel in many ways . . . and therein lies a story of castings. Quite some years ago, Campbell, Wyant and Cannon realized the wealth of benefits in store for engine user and engine manufacturer if a camshaft could be cast successfully. So CWC put engineering and research to work . . . developed special electric furnace alloys far superior to any previously used materials.

Since that time, CWC has delivered over 40 million cast camshafts . . . saved engine builders well over 50 million dollars. In addition to being produced at lower cost, these camshafts are heat treated to resist corrosion and wear for the life of the engine. They need little machining, are easier to machine and actually extend design possibilities of the engine.

It will pay to consider castings for your product. Many others have found the most important step is to contact CWC.

CAMPBELL, WYANT AND CANNON
FOUNDRY COMPANY
Muskegon, Michigan
GRAY IRON, ALLOY IRON AND STEEL CASTINGS

Designed



Years ahead styling—with designs of distinction and durability created exclusively for your organization by America's foremost stylist—makes Fraser Seat Covers a complement to any car.

FRASER PRODUCTS COMPANY
ALPENA, MICHIGAN
A DIVISION OF
DETROIT GASKET & MANUFACTURING COMPANY

the chilled-iron face gives Eaton Tappets superior load-carrying capacity and longer life

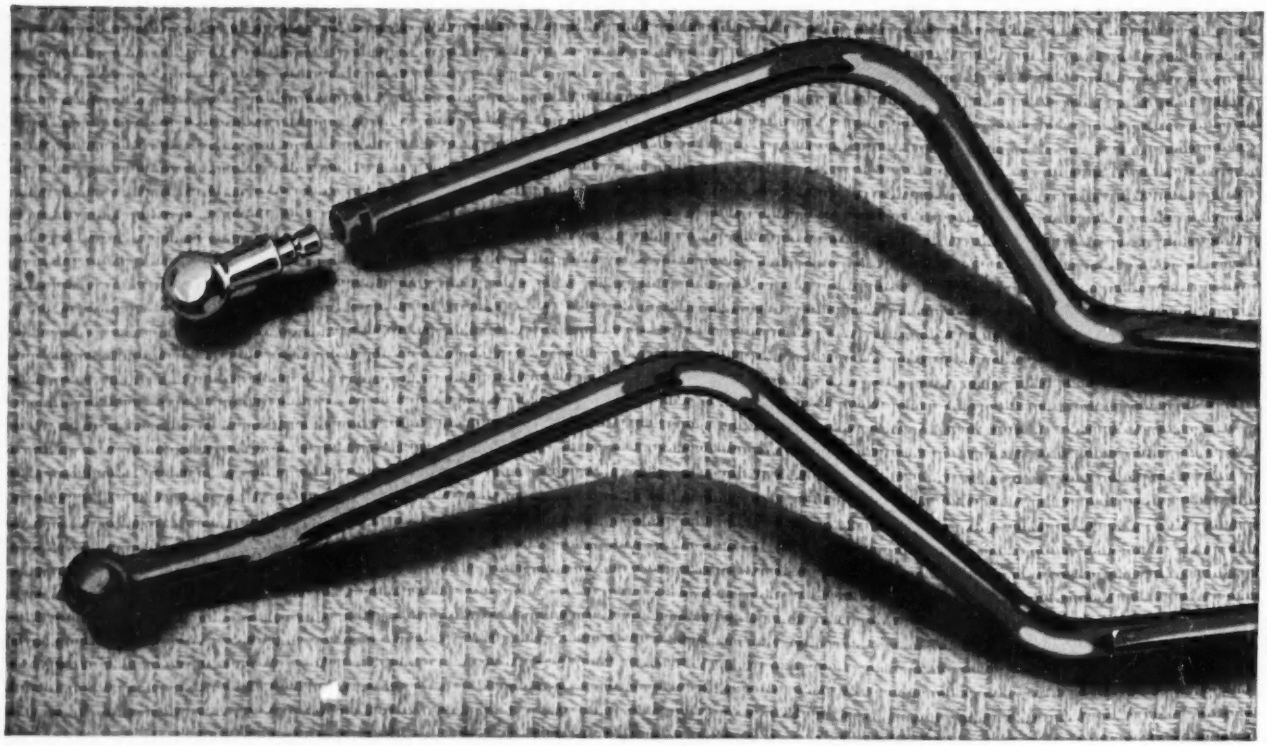
To keep pace with the requirements of today's higher-speed, higher-compression engines, Eaton has developed special foundry facilities to produce chilled-face tappets with essential hardness and wear-resistant characteristics. Eaton offers volume-produced, volume-priced, lightweight tappets capable of carrying excessively high loads. From the ladle to final inspection, the wear-resistant hardness of the face and the over-all quality of Eaton tappets are guarded by precise metallurgical control.

EATON MANUFACTURING COMPANY

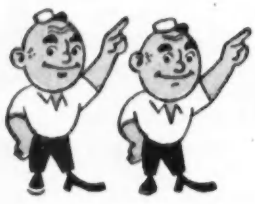
General Offices: CLEVELAND, OHIO

SAGINAW DIVISION: 9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers



Three-piece accelerator rod simplified to one piece of Bundyweld Tubing



WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

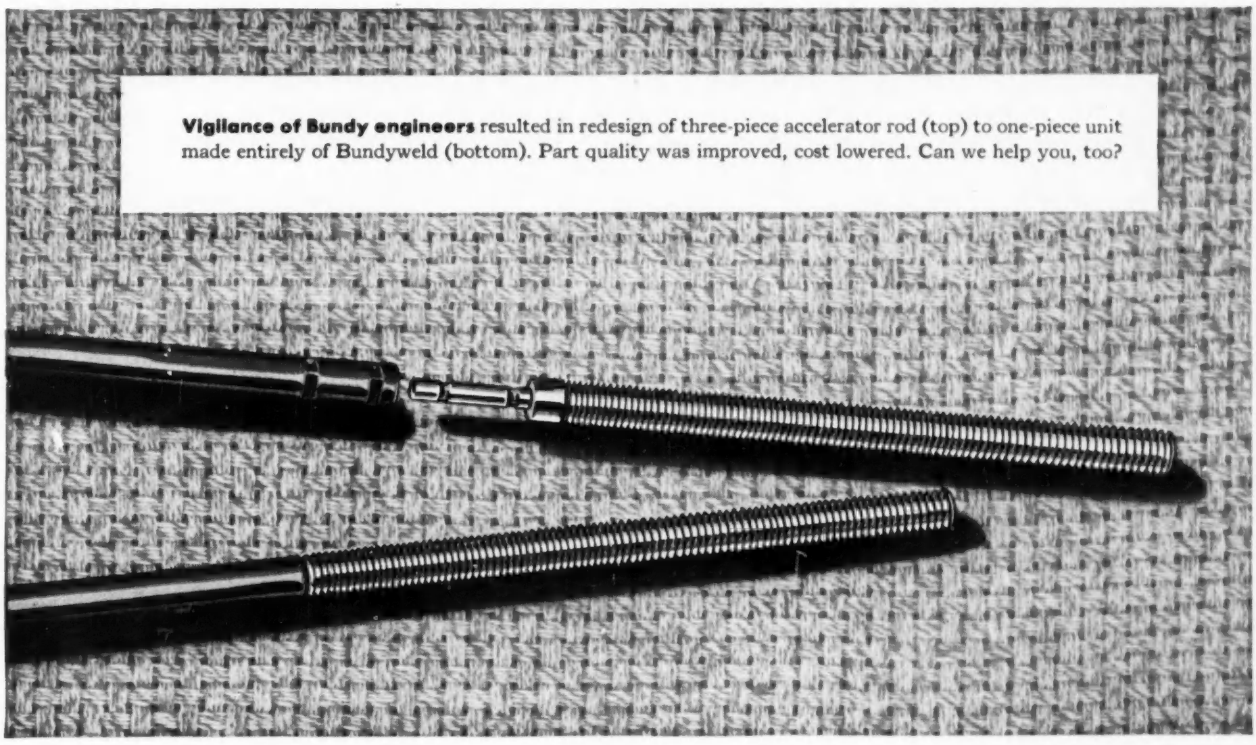
passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

← **NOTE** the exclusive Bundy - developed beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., East. • ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Los Angeles 58, Calif.:*** Tubesales, 5400 Alcoa Ave.

Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.



Vigilance of Bundy engineers resulted in redesign of three-piece accelerator rod (top) to one-piece unit made entirely of Bundyweld (bottom). Part quality was improved, cost lowered. Can we help you, too?

A Bundy customer's accelerator-rod design called for a threaded rod and a ball-end to be mechanically held in opposite ends of a piece of formed ¼" O.D. Bundyweld Tubing.

While we produced the rod according to specifications, our engineers took a good hard look at the part. They soon came up with a simple, sound idea to produce a stronger, more durable part at less cost to our customer.

You see the result above—a one-piece accelerator rod of Bundyweld Tubing threaded on one end, expanded and formed into a ball at the other. Perhaps you can see several factors that will work to *your* advantage, too.

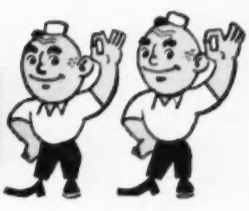
Take Bundyweld itself, for instance. It's the automotive industry's standard of dependability. It's the only tubing double-walled from a single strip, copper-bonded throughout 360° of wall contact. It has high tensile strength, high yield strength, high fatigue limit. And, of course, there's almost nothing that it won't take in the way of fabrication beating.

When you hand us the design for a tubing part, we're geared to produce it in volume to your specifications—thanks to Bundyweld and thanks to our skilled men and Bundy-developed bending machines. But if we can suggest a cheaper way of making the part or a way of improving it, or both, we'll speak up. It's our policy to do so. If you're set up to handle your own fabrication operations, however, we'll be glad to ship you clean straight lengths of Bundyweld.

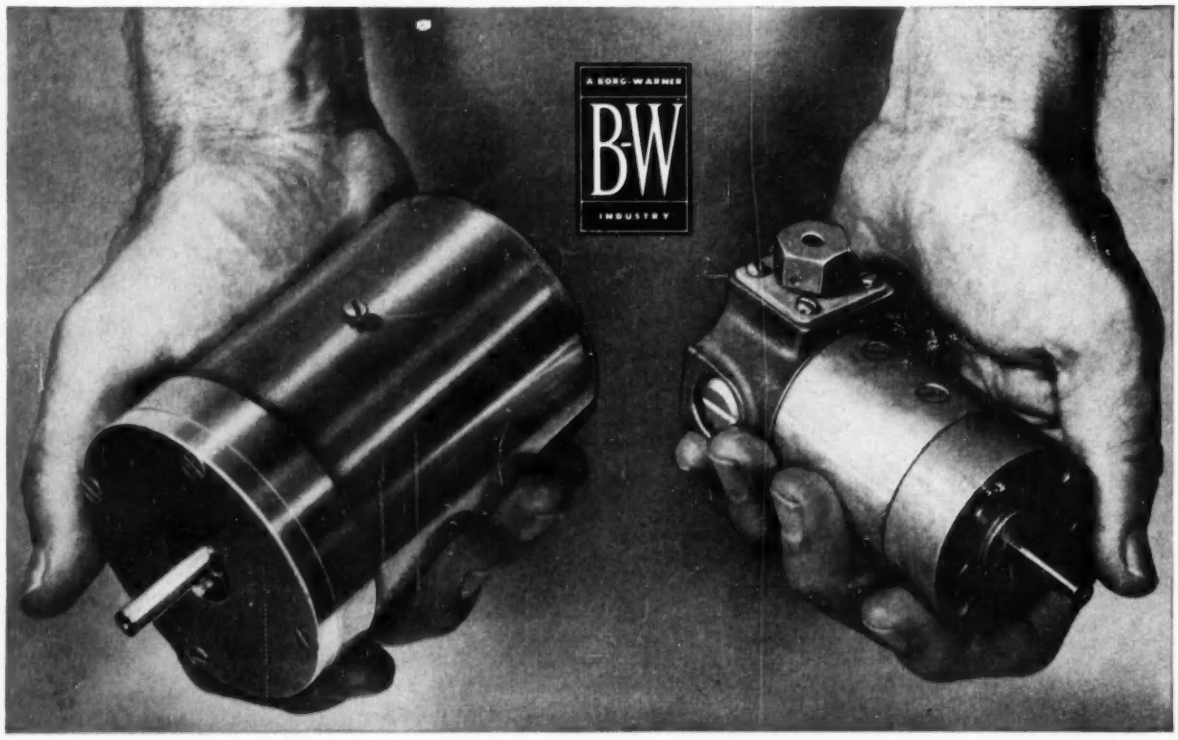
For an improved, lower-cost accelerator rod—or for that matter, for leakproof brake, gasoline, and oil lines, talk things over with a Bundy tubing specialist. Call, write, or wire Bundy Tubing Company, world's largest producer of small-diameter tubing.

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

Bundyweld Tubing®



DOUBLE-WALLED FROM A SINGLE STRIP



Compact, powerful, custom-built A.C. or D.C. motors for ELECTRONICS and ELECTRO-MECHANICS

Wherever you need electric motors for maximum power in minimum size, Pesco has the basic co-ordinated frame sizes and power elements you'll require.

For example—Pesco motors are now in use for: cooling (blowers for electronic equipment), tuning (radios and automatic finders), scanning antenna (civilian and military), antiaircraft radar fire control, as well as pump drives and mechanical actuators.

By using standardized parts in a series of six co-ordinated frame sizes, Pesco can provide you with electric motors for electronic applications with voltages from 6 to 120 volts D. C.; from 1/100 to 6 H. P. for operating speeds up to 15,000 R. P. M. Special, high-altitude design will operate from –65° to + 165° F.

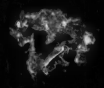
Pesco high-frequency A.C. induction motors, squirrel-cage type, are built in a series of 5 co-ordinated frame sizes to meet horsepower requirements of .01 to 9.0, at 400 cycles per second.

Motors in these frame sizes can be built for *your* specific frequency, using standard parts to obtain the speed and power rating desired. Consult our Engineering Department concerning your requirements. Strictest confidence—and no obligation, of course!

engineering Pesco production
PRODUCTS DIVISION

BORG-WARNER CORPORATION
24700 NORTH MILES ROAD • BEDFORD, OHIO

greatest name in diesel fuel injection...



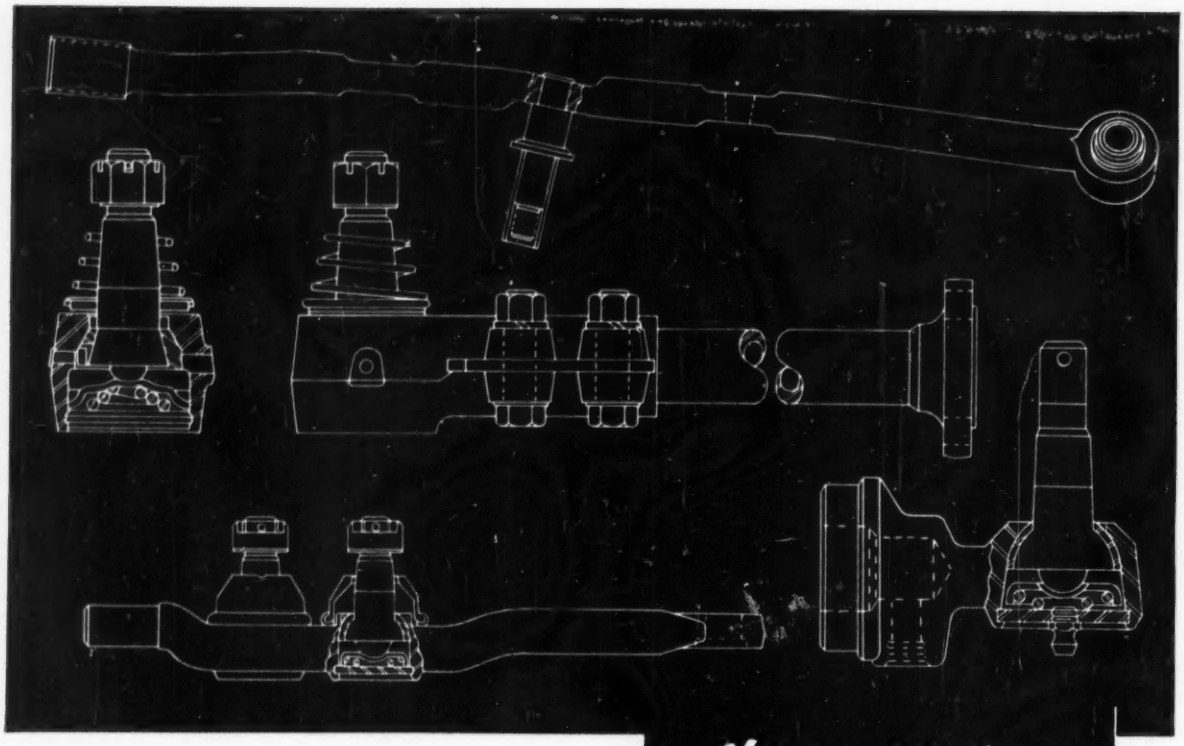
AMERICAN
BOSCH

Look to American Bosch
for continued leadership
in diesel fuel injection.

Engineered Linkage for POWER STEERING

Power steering for the new automobiles, trucks and tractors presents new steering problems—necessitates special and far more complicated steering linkage components.

Just as Thompson's "Steering Engineers" helped solve the problems presented by front wheel brakes, by redistribution of car weight due to relocation of engines, by increased movement of front wheels due to more efficient suspension and precise location of linkage parts with relation to high point on the gear—they have engineered and developed many steering linkages that are required by power steering. Illustrated are 4 of these.



Thompson's "Steering Engineers" welcome the opportunity to work with all car, truck and tractor makers in solving their steering problems. Write, wire or telephone Thompson Products, Inc., 7881 Conant Ave., Detroit 11, Michigan. WA 1-5010.

You can count on

Thompson Products

MICHIGAN PLANT

DETROIT · FRUITPORT · PORTLAND

STROMBERG

CARBURETORS

Lasting

Performance in Today's Cars Will be Tomorrow's Strongest Selling Point!

Today, more than ever, new car buyers are looking for features that assure long, satisfactory performance. Engine components that contribute to this accomplishment now assume even greater importance as they not only influence today's sales, but become tomorrow's strongest selling point.

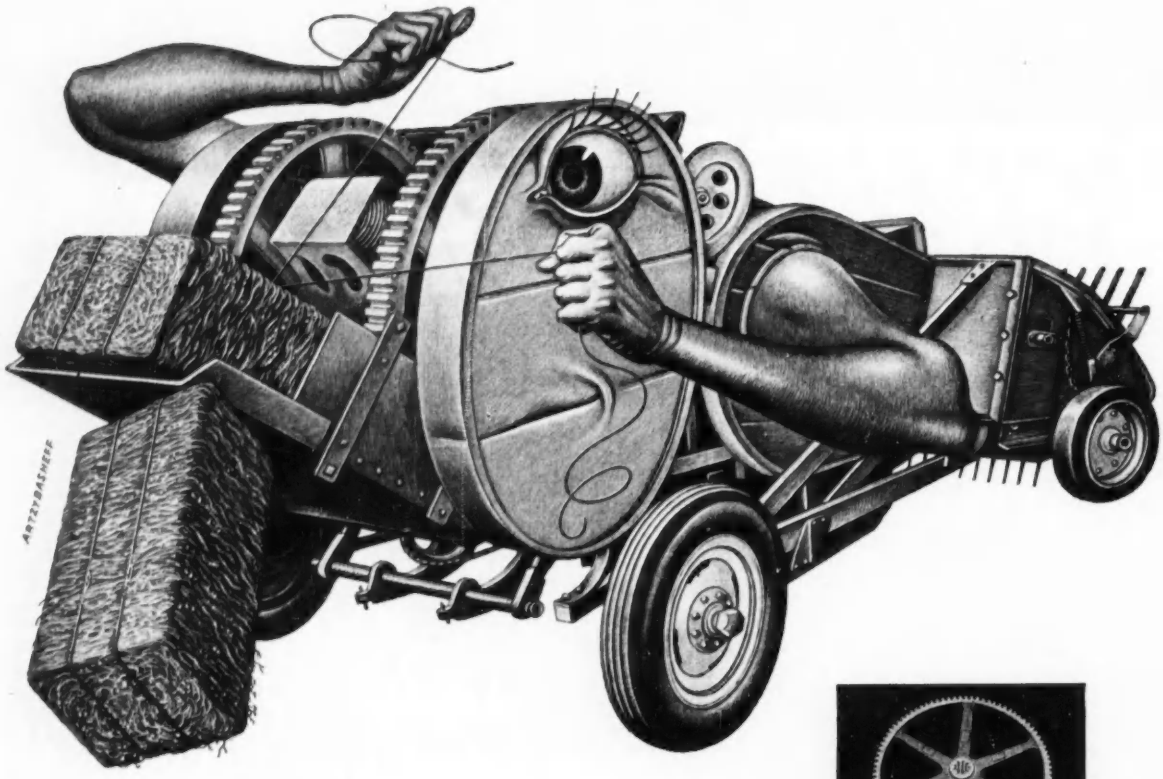
For owner loyalty as well as immediate sales, it pays to specify Stromberg* — the carburetor built for *lasting performance.*

*REG. U. S. PAT. OFF.

ECLIPSE MACHINE DIVISION OF Bendix AVIATION CORPORATION

- **Standard Equipment Sales: Elmira, N. Y.**
- **Service Sales: South Bend, Ind.**

Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.



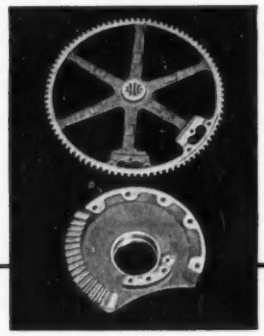
Strong "wrists" for America's new hay balers

Whisking through fields of hay . . . picking up and handling an almost incredible 2,500 bales per day . . . this man-saving, time-saving, money-saving NEW IDEA hay baler needs mighty tough gears to keep its tying mechanism on the job. To be certain these steel "wrists" have maximum strength and durability . . . NEW IDEA looks to Lycoming.

Do *you* need a precision part . . . volume production of a metal product . . . a dependable air-cooled engine . . . or development of "just an idea" in the rough or blueprint stage? Then remember—many of America's industrial and military leaders credit Lycoming with solving their most complex metal-working problems. Whatever your problem . . . *look to Lycoming!*

More than 6,000 machine tools, a wealth of creative engineering ability, and 2½ million square feet of floor space stand ready to serve your needs when you look to Lycoming.

AIR-COOLED ENGINES FOR AIRCRAFT AND INDUSTRIAL USES • PRECISION-AND-VOLUME MACHINE PARTS • GRAY-IRON CASTINGS • STEEL-PLATE FABRICATION



For sturdy, unfailing spur and bevel gears—"wrists" that drive the tying mechanism of its "one-man" hay baler—NEW IDEA looks to Lycoming for precision production.

For a more complete story on Lycoming's varied abilities and facilities, write—on your company letterhead—for the illustrated booklet, "Let's Look at Lycoming."

FOR RESEARCH • FOR PRECISION PRODUCTION

LOOK TO **LYCOMING**

Lycoming-Spencer Division, Williamsport, Pa. AVCO Bridgeport-Lycoming Division, Stratford, Conn.

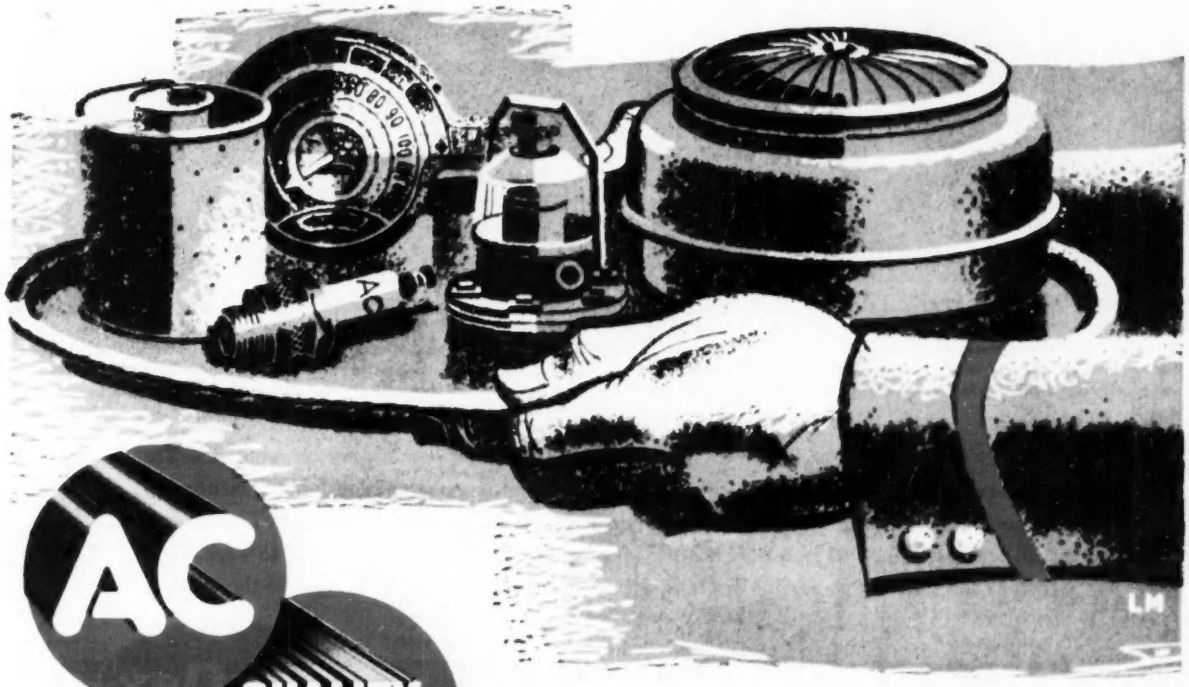
FUNDAMENTAL FACTORS IN EQUIPMENT LEADERSHIP

Serving 300 MAJOR MANUFACTURERS

The AC Spark Plug Division now serves over 300 manufacturers. These customers, and *their* customers, add up to many millions of satisfied users of the many AC Quality Products.

Each and every piece of specialized equipment that AC has been asked to develop has benefited by AC's scientific know-how and manufacturing experience. Each has helped AC's customers to manufacture more salable end products.

This very practical method of applying AC's 45 years' experience toward product improvement is available to *you*. Why not investigate? Just contact one of the AC offices listed below.



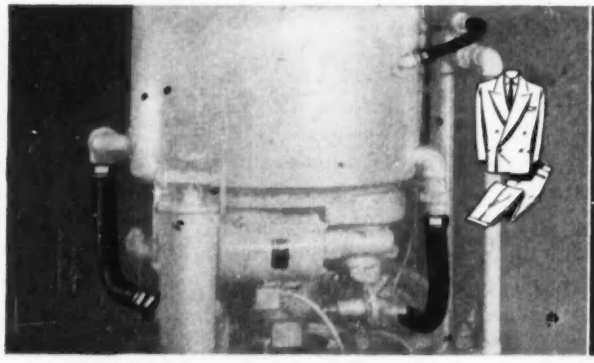
AC QUALITY PRODUCTS

FLINT—1300 North Dort Hy.
CHICAGO—Insurance Center Bldg.
DETROIT—General Motors Bldg.

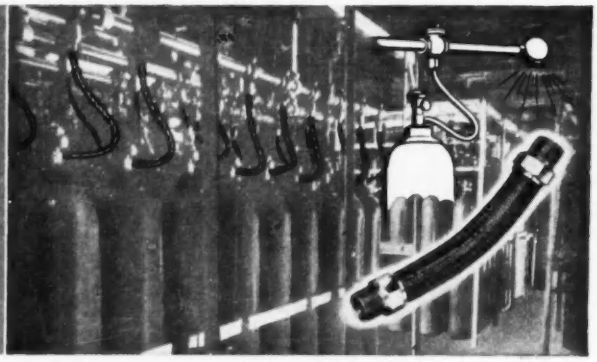
• ADAPTERS (Drive) • AIR CLEANERS • AIR CLEANERS AND SILENCERS (Combination) • AMMETERS • BREATHERS (Crankcase) • CAPS (Radiator Pressure) • FLEXIBLE SHAFT ASSEMBLIES • FUEL PUMPS • FUEL AND VACUUM PUMPS (Combination) • FUEL FILTERS & STRAINERS • GASOLINE STRAINERS • GAUGES—AIR (Pressure) • GAUGES—GASOLINE • GAUGES—OIL (Pressure) • GAUGES—TEMPERATURE (Water, Oil) • OIL FILTERS (Lube) • PANELS (Instrument) • SPARK PLUGS • SPEEDOMETERS • TACHOMETERS • TERMINALS (Ignition Wire) • VALVES (Crankcase Ventilation)

AC SPARK PLUG DIVISION GM GENERAL MOTORS CORPORATION

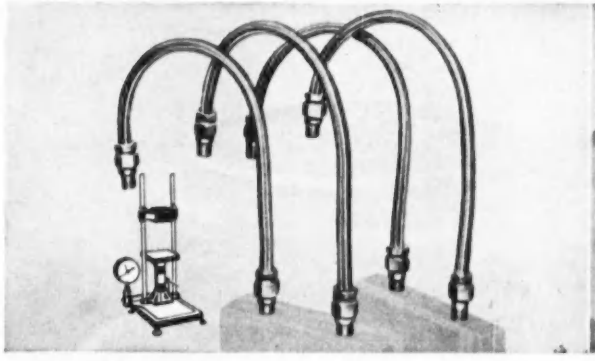
Pick an idea—lick a design problem...



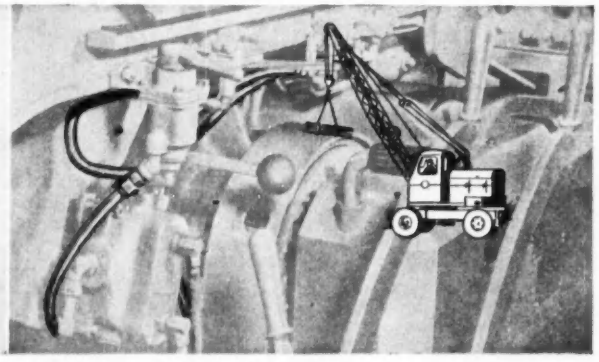
END VIBRATION AND LEAKAGE. Titeflex® metal hose, used as fill and drain lines of SEC Synthetic Cleaning Units, kills vibration and prevents solvent leakage at fittings. Tough, wear-and-corrosion-resistant Titeflex is just as effective in handling steam, oil, lubricants, fuels, gases, brine, acids, compressed air or oxygen. Design and construction of Titeflex assure trouble-free performance. Excellent for projects involving extreme configurations.



CONTROL CRITICAL PRESSURES. How would you connect 280 cylinders of fire-extinguishing carbon dioxide at 850 psi to line? Walter Kidde & Company licked this problem with Titeflex flexible metal hose which met all insurance standards and withstood rigid application requirements. Titeflex also conveys hundreds of different fluids under as many different temperature and pressure conditions. Resists corrosion, vibration, physical abuse.



CONDUCT STEAM SAFELY. Plates for Carver Laboratory Press carry steam up to 200 psi (nearly 400°F.) for heating—water for cooling. The connections are flexible, pressure-safe Titeflex. Braiding gives extra strength. Added problems of vibration, pulsation, continuous movement, corrosion or abrasion make Titeflex invaluable in scores of other applications.



FIGHT FATIGUE AND WEAR. Titeflex metal hose eliminated maintenance on air control lines of Unit Mobile Cranes. All-metal construction, with braiding woven directly upon the hose, provides great strength and resistance to vibration, corrosion, wear and abuse. Flexibility of Titeflex permits simplified assembly even where space configurations are problems.

THE USES FOR TITEFLEX® seamed flexible metal hose and Uniflex seamless flexible metal hose are limited only by engineering ingenuity. And Titeflex design engineers—working *with* customers—develop new applications daily. Somewhere in your plant or on your products Titeflex can improve operation and maintenance—or simplify a design problem. Our *new 48-page Metal Hose Catalog* No. 200 shows you how and why. To get your free copy, simply mail the coupon.

Let Our Family of Products Help Yours

Titeflex

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Please send me without cost information about the products checked at the left

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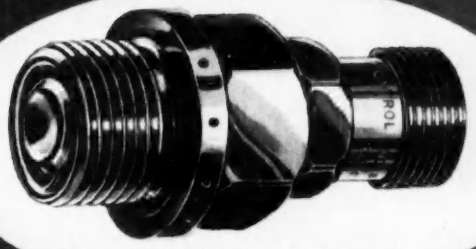
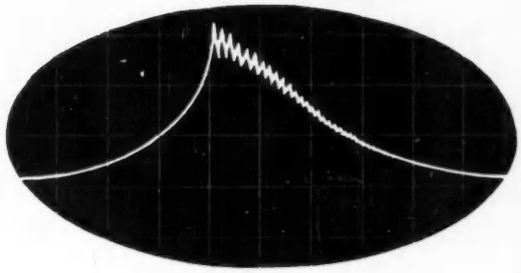
FOR THE FIRST TIME

A COMPLETE PRESSURE PICTURE



NORWOOD CONTROLS Type EP Pressure Pickup



Versatility — for use in dynamic systems . . . tested and proven on gasoline and diesel engines . . . jet engines . . . rocket motors . . . blast measurements . . . high pressure, high temperature chemical reactions . . . hydraulic and pneumatic systems.

Full Scale Pressures — 500, 1,000, 2,000, 3,000, 5,000, 10,000 psi . . . response down to 0 psi absolute with 1% of full scale accuracy and temperature compensation.

High Frequency Response—flat to 20,000 cps . . . natural frequency up to 45,000 cps.

Flush Catenary Diaphragm — reduces changes in volume of pressure chamber to a minimum.

A word about NORWOOD CONTROLS — This name stands for an expanding line of commercial instruments for the measurement of pressure, flow, temperature and weight. It represents a fresh concept of creative engineering which, combined with New England manufacturing skill, is establishing new frontiers in the field of instrumentation.

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CONTROL ENGINEERING CORPORATION
562 Providence Highway, Norwood, Massachusetts

Norwood Controls representatives are located in principal cities.
Complete technical information will be supplied upon request.

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FULL-FLOW RING SETS

1 Top compression ring of chrome-alloy cast iron has solid chrome face, factory-lapped to a light-tight finish, with sides Granosealed for greater flexibility.

2 MD-50 Steel Oil Ring with the Full-Flow Spring has chrome-faced side rails for double mileage, with sides Granosealed for greater flexibility.

3 All rings in Sealed Power KromeX Ring Sets are beveled or tapered to threadline contact for quicker seating and blow-by control.

25 leading engine builders now use Sealed Power chrome rings!

Sealed Power Piston Rings

SEALED POWER CORPORATION • MUSKEGON, MICHIGAN

Sole manufacturers of KromeX Ring Sets, MD-50 Steel Oil Ring, Full-Flow Spring, Flex-S Flexible Oil Ring, and GI-60 Groove Inserts.
Leading Producer of Automatic Transmission Rings, Power Steering Rings and Non-Spin Oil Rings.

LEAR GIVES SURE CONTROL FOR COWL FLAPS ON CONVAIR 340

To MATCH its exceptional ability to "get up and go," the versatile Convair Liner 340 needs precision control of its engine cowl flaps. Positive action and exact positioning for this important function are provided by Lear screwjacks.

Lear screwjacks form but one part of a comprehensive line of Lear electro-mechanical actuating products for aircraft use. Their compact design, light weight, high strength, and precision operation spell out the reasons for the use of Lear electro-mechanical products on almost every commercial and military aircraft flying today. Let us discuss *your* electro-mechanical problems. We will either have the answers on hand or be able to develop them quickly.

LEAR MODEL 550 SCREWJACK *(shown above)*
Combines with three similar units to complete a positive, non-reversing engine cowl flap control system for the Convair 340. The entire assembly is actuated by a common power source through a Lear system of flexible shafting, which can be utilized to transmit power to additional accessories.

EM-4

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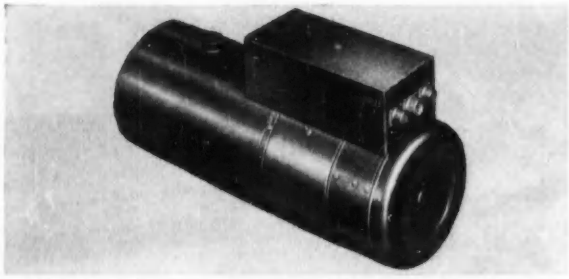
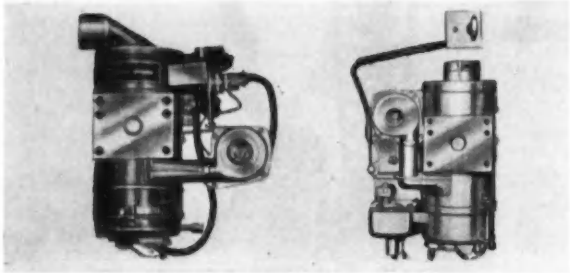
Executive Offices: 3171 S. Bundy Dr., Los Angeles 34, Calif.

When the chips were down

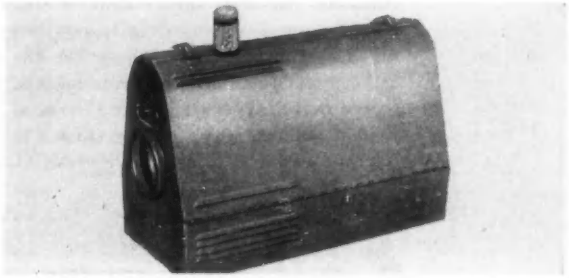


Model E-511 Coolant Heater for liquid-cooled gasoline and diesel engines. Puts 60,000 B.t.u. per hour into coolant.

Model E-510. Fresh-Air Heater. 60,000 B.t.u. per hour. Delivers more *actual fresh-air heat* than *any* other unit of this type. Designed for engine, cargo, personnel heating.



Series 460 and Series 590. Coolant and Direct-Fired Engine Heaters. Each heater is a complete package requiring only electric, fuel, coolant and exhaust connections.



Model E-600 Portable Heater. 60,000 B.t.u. fresh-air output. Meets the need for a complete heating unit that is easily portable. Operates on 110 V.

...they called on Perfection

The Armed Forces had to have an absolutely safe and dependable personnel heater for the hard-slugging M-48 and T-43 tanks. They had their pick of the heaters on the market but they *standardized* on Perfection Fresh Air Heaters.

They did this after rigorous tests in Perfection's own 90 below zero Cold Room and in the field *proved* that the Perfection E-500 was the safest, most dependable and efficient heater for the job.

The same practical engineering and production skills that turned out the E-500 . . . the same 11-years of uninterrupted specialization in designing complete winterization kits for all types of vehicles and equipment and heaters for personnel, cargo and engines is available to help you.

If you're building or putting equipment into service for sub-zero or Arctic operation, call in Perfection early on the project! Write for information.

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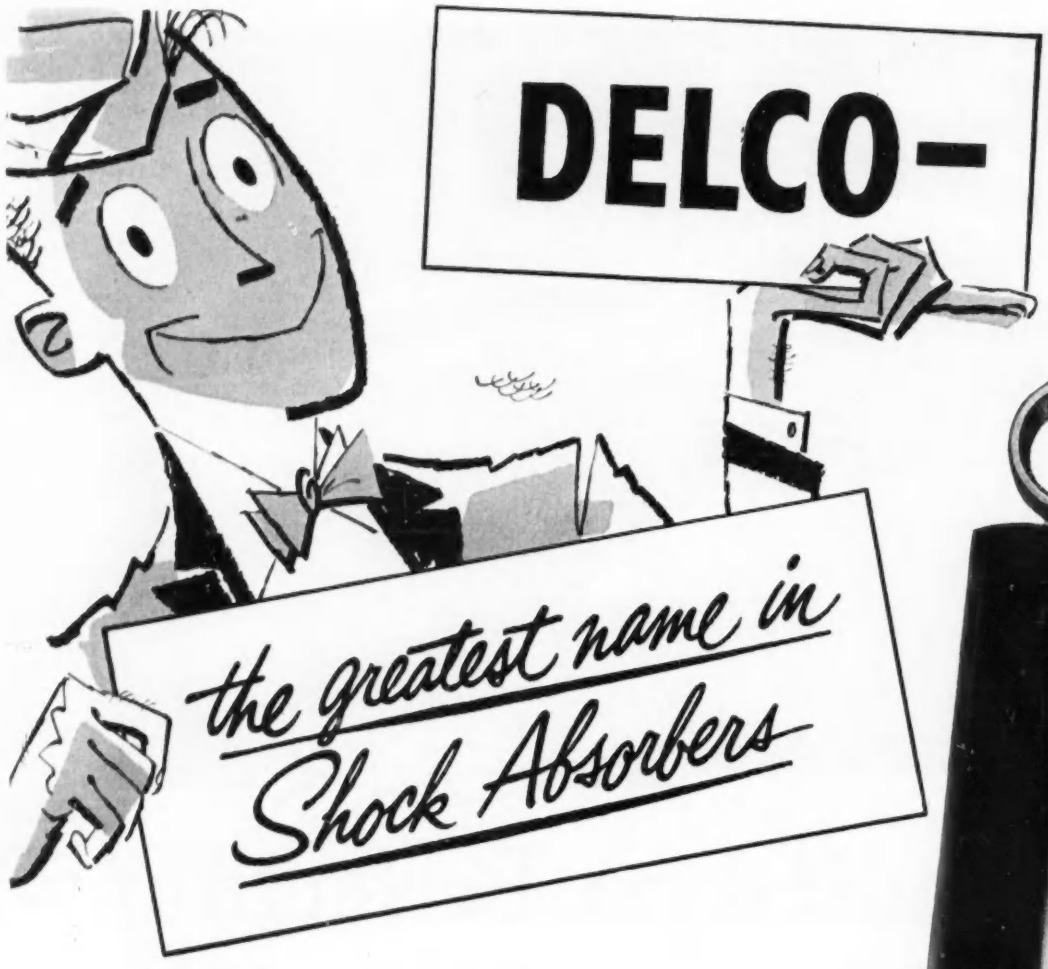

for . . . quality
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A combination of experience, research and technical knowledge has made Delco the foremost producer of shock absorbers . . . has made Delco the best-known, the most-wanted shock absorber.

There are Delco designs for every automotive application —cars, trucks, buses, military vehicles—and Delco production facilities insure prompt delivery. For detailed information get in touch with Delco Products, Division of General Motors Corporation, Dayton, Ohio.

Delco Hydraulic Shock Absorbers

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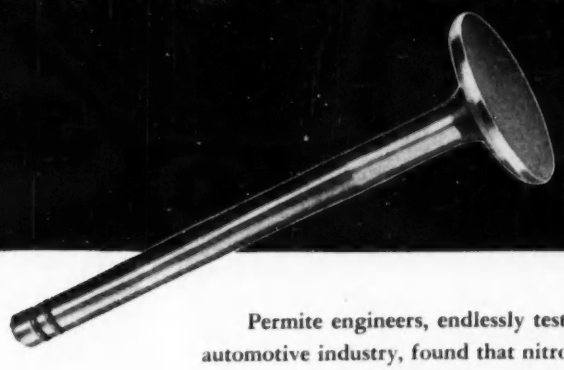
. . . the element that gives TNT its POWER now gives Permite Valves their STRENGTH



Permite engineers, endlessly testing for products to better serve the automotive industry, found that nitrogen added to Austenitic steel of the 21-chrome type definitely increases the ability of this alloy to resist heat and corrosion. Nitrogen increases the valve's strength at least 25% and its hardness 40% when operating at elevated temperatures.

Permite exhaust valves with nitrogen added, the valves that are used in many of today's leading automotive engines, are typical of Permite's contribution to automotive progress.

For over 30 years, Permite engineers have cooperated with automotive and industrial engine builders in developing valves, pistons and other parts to promote better engine performance. We invite consultation on your requirements.

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For Piston rings to meet every requirement
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our engineering know-how is at your disposal.

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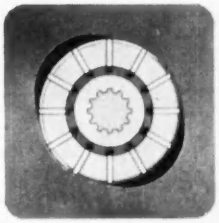
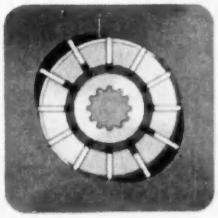
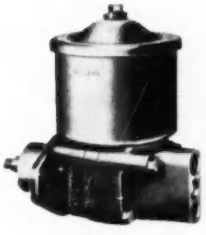
. . . when a VICKERS® vane type pump is used for hydraulic power steering



This schematic diagram of a Vickers pump shows how sliding vanes are retracted at normal engine cranking speeds. No oil is pumped and there is practically no starting load.



Similar diagram of Vickers pump shows how pump vanes are extended when engine is running. Pumping then begins and continues at all engine speeds.



Vickers Pump with integral volume control and relief valves and oil reservoir.

Vickers Pump with integral volume control and relief valves.

In cold weather, the starting load is multiplied while battery power is greatly reduced. Under severe conditions any added load may be enough to make the difference between starting and not starting.

In power steering, a hydraulic pump with fixed teeth or lobes may add greatly to the starting load. On the other hand a Vickers Balanced Vane Type Pump adds practically nothing to the starting load because it does not pump oil until the engine fires (see sketches at left). As a result, cars with power steering that uses a Vickers Pump start much easier in cold weather.

There are numerous other reasons why Vickers pumps are now in use on many leading automobiles with power steering.

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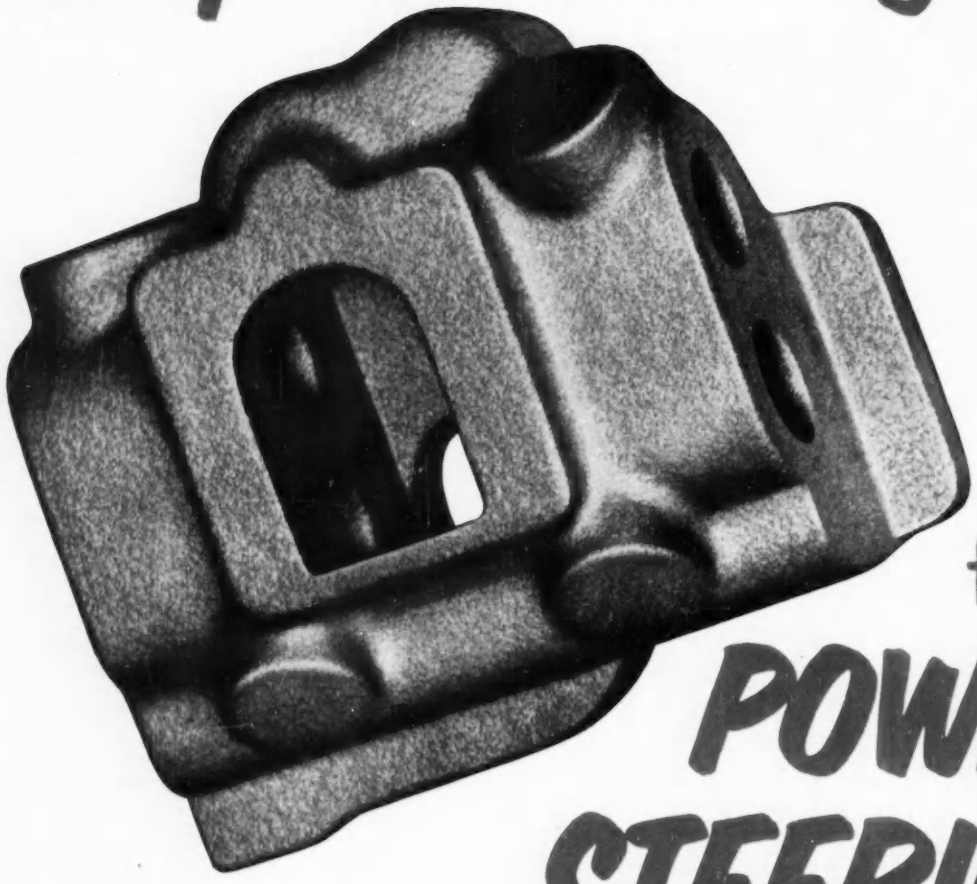

for POWER STEERING

Send for your free copy of the 32-page illustrated booklet: "The Eaton Permanent Mold Foundry." It tells the story of Permanent Mold Castings and takes you on a picture-tour of the Eaton Foundry at Vassar, Michigan.

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PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

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"U. S." Production builds it

In the great laboratory in the United States Rubber Company plant at Fort Wayne, scientists and engineers are working on problems involving rubber-to-metal parts and plastic parts for the automotive industry. They have at their command one of the most modern and extensive laboratories in existence – equipped with all the latest research and development facilities. "U.S." RESEARCH PERFECTS IT.

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UNITED STATES RUBBER COMPANY

Automotive Sales, Mechanical Goods Division, New Center Bldg., Detroit 2, Michigan

The Thompson power steering pump is an internal gear pump with integral combination flow-control and relief valve. It features uniform flow characteristics, better distribution of driving pressure, improved operating efficiencies and competitive manufacturing costs.

Thompson's hydraulic pump is used to actuate tractor implements and features pressure loaded end plates which compensate for wear and results in maximum efficiency and longer service life.

YOU CAN COUNT ON

Thompson Pumps

DIFFERENT pumps present different problems in their design, development and production. With a power steering pump it may be quiet operation; with a farm implement pump it could be the need for longer service life; always there must be dependable operation.

But, whatever the problem, Thompson is equipped to solve it. Over 50 years experience in the research and production of precision-engineered parts enables Thompson today to manufacture pumps which assure maximum performance and dependability.

In addition to maximum performance ratings, Thompson pumps are also engineered to meet competitive manufacturing costs. Our engineers will gladly work with you to design pumps for your specific application—whether you require a power steering pump, a farm implement pump, or some type industrial pump. Write, wire or phone Special Products Division, Thompson Products, Inc., 2196 Clarkwood Road, Cleveland 3, Ohio.

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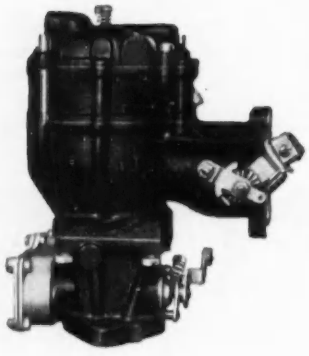
Zenith CARBURETORS



No manufacturer could long exist in the competitive commercial vehicle field without drawing heavily on previous owners for new vehicle sales. It is perfectly obvious, no owner would buy the same make vehicle again and again unless it has delivered satisfactory performance. Therefore, it is just good business to see that every component contributes its share toward building owner loyalty. That's why manufacturers whose vehicles are Zenith* equipped measure carburetion costs in lasting terms rather than initial expense. In the field of heavy-duty carburetion, one name, Zenith, has stood for lasting satisfactory performance for over a quarter of a century. Zenith's rugged construction, strong idling, freedom from stalling and response to every demand make it the engineers' choice. For good will, it's good business to specify the best—Zenith for lasting performance.

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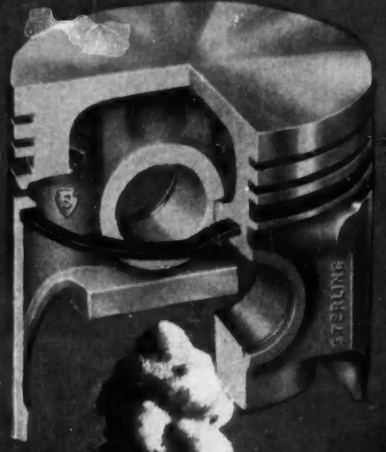

Now Allows You To Specify Your Own Piston Clearance!

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Tests now prove that by varying the strength and design of the steel insert we can pre-determine piston skirt expansion and contraction to meet any engine clearance specification.

CONSTANT CLEARANCE over the entire temperature range from −20° F. to 200° F. Closer clearances than ever before possible without danger of scuffing or seizing.

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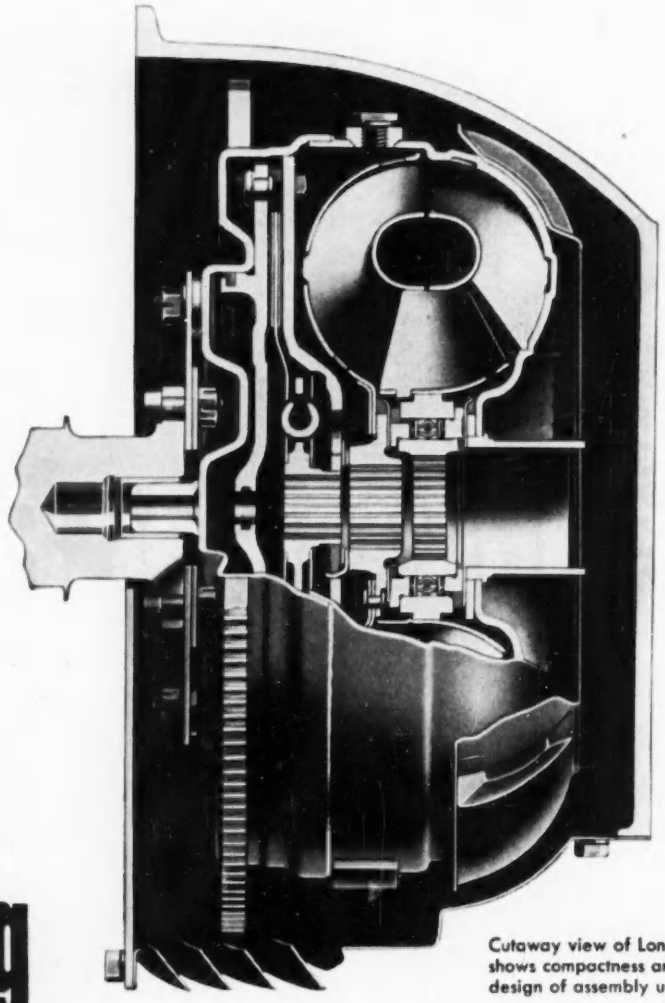

Cutaway view of Long torque converter shows compactness and clean, functional design of assembly units

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less weight per horsepower a problem, too?

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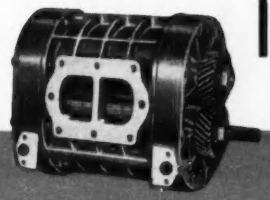
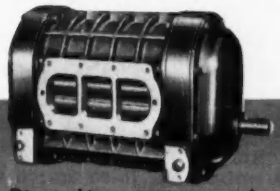
are engineered to match your exact requirements

And when you put M-D Superchargers on your engines you're assured of efficient operation plus long life and low maintenance service. Exclusive M-D features make this possible. Result: dividends in fuel economy and maintenance costs.

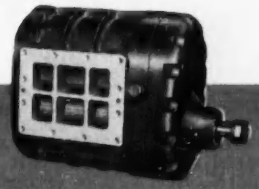
On small jobs as well as large, M-D engineers will be glad to work with you—to help you get the exact size and type of supercharging equipment for your purpose. Write for technical brochure with specifications and performance data.



Typical direct driven, flange mounted M-D Supercharger. Develops 350 c.f.m. at 10,000 r.p.m. Other models with capacities to 4,000 c.f.m. available.

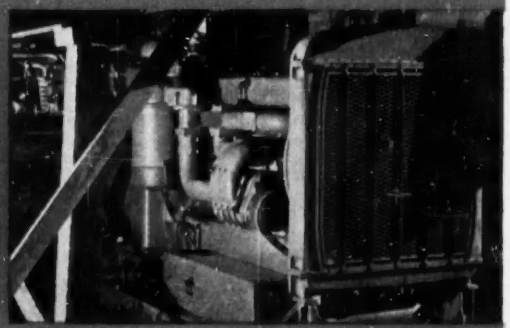


Direct driven, port mounted, Model 37100. Maximum 920 c.f.m. at 7000 r.p.m.



Belt driven, port mounted Model 5511 develops 1250 c.f.m. at 4000 r.p.m.

Supervisors at an Arizona pit mine report big, fast-moving M-D supercharged Diesel trucks climb stiff grades with power aplenty . . . sharply cut maintenance costs in moving overburden.



Supercharged Diesel power pays off in this rock crushing plant. The M-D Supercharger puts 50% more horsepower in the engine . . . reduces weight per horsepower by 20%. Easier portability.

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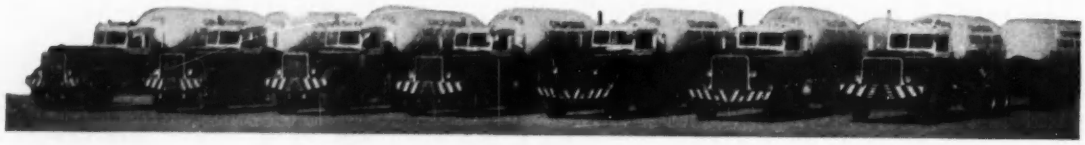

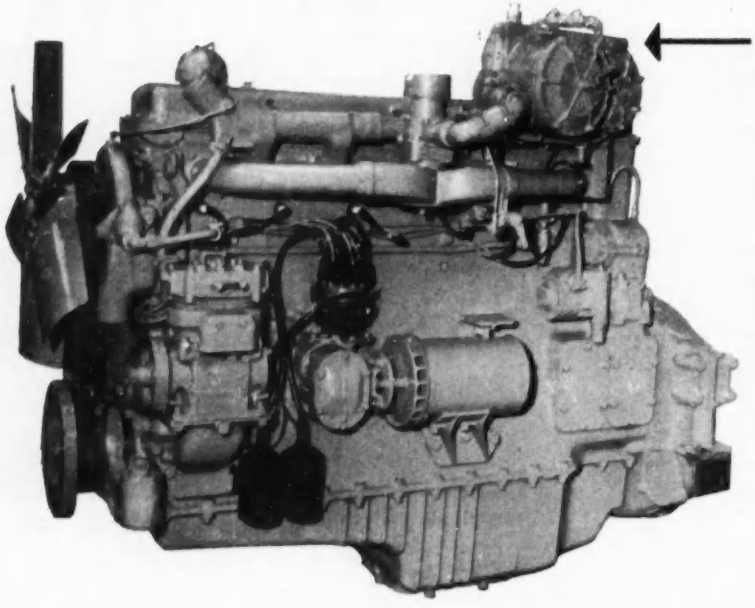

Hall-Scott engineers specify cylinder heads and blocks in nickel alloyed iron to increase wear-resistance, and to improve machinability regardless of section size. To solve the problem of blow-by and assure maximum mileage between overhauls, they specify pistons equipped with a top ring groove insert of Ni-Resist®, a high nickel alloy iron... which effectively resists wear, heat and corrosion. And they utilize the strength and toughness of nickel alloy steel studs in the upper crankcase passing through the block and the head to hold the entire engine rigid and cylinder bores free from distortion. Crankshaft, connecting rods, valves... in fact, practically all vital parts are of alloys containing nickel to meet various combinations of operating, service and fabrication demands.

How a Hall-Scott Six

DEVELOPS { 310 BHP with Gasoline / 346 BHP with Butane

with vital parts made from nickel alloyed irons and steels

This dual-fuel six cylinder engine now in production at the Hall-Scott Motor Division, ACF-Brill Motors Company, Berkeley 10, California, requires only slight modifications to convert it from one fuel to the other.

Designed for trucks and industrial uses, this high-powered unit weighs but 2300 pounds and exemplifies how alloys containing nickel give greater play to the skill of automotive engineers.

From among the many engineering alloys containing nickel, you can select a material to provide the best set of properties for meeting one or a combination of requirements. The caption above indicates how Hall-Scott engineers used alloys containing nickel to obtain distinct advantages.

When you have a metal problem, send us details for our suggestions.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

EMBLEM OF INCO SERVICE

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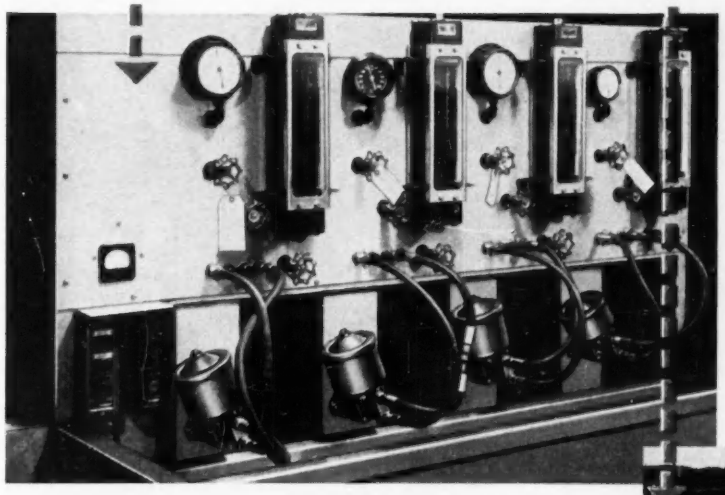
Laboratory and GM Proving Ground "Torture Tests" Make SURE Every Part Has Plenty to Spare . . .



● On this specially-designed Saginaw test stand, batteries of hydraulic pumps are run continuously for *680 hours without a rest:* 30 hours under "parking load" of 650 pounds pressure; 150 hours under "cornering load" of 200 pounds pressure; finally 500 hours under 500 pounds load to test their durability. Wear and tear is greater than the pumps will be subjected to in the entire life of the average car.

When it comes to a mechanism as vital to safety as Power Steering, you've got to be *sure—and you are with Saginaw!*

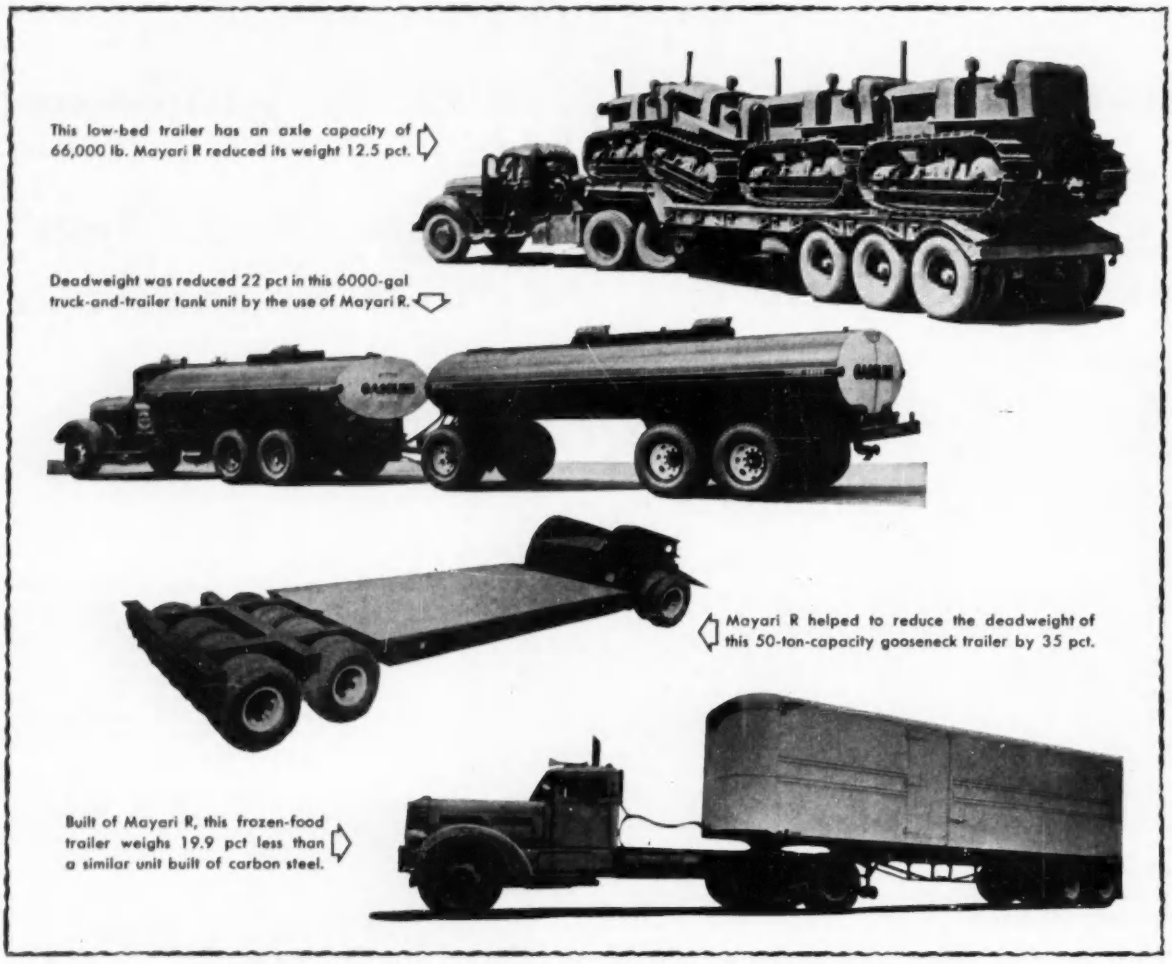
First, an ample *Safety Factor*—more stamina than will ever be needed—is engineered into the sturdy Saginaw design. Then, to make doubly sure, we force each component to absorb far more punishment than it will ever get in normal service. Both in our research laboratory and at the General Motors Proving Ground, Saginaw Power Steering units take the terrific kind of beatings you see illustrated here—and come through with flying colors.

That's why you can be so sure Saginaw Power Steering is thoroughly dependable. It is built by experts who *specialize* in steering gears—and safety comes first with Saginaw—*always!*

● Over some of the world's roughest, toughest roads at the General Motors Proving Ground, Saginaw Power Steering units prove again they can "take it." Few drivers will ever encounter driving conditions as demanding as these.

Saginaw
POWER STEERING

SAGINAW STEERING GEAR DIVISION, GENERAL MOTORS CORPORATION, SAGINAW, MICHIGAN


This low-bed trailer has an axle capacity of 66,000 lb. Mayari R reduced its weight 12.5 pct.
Deadweight was reduced 22 pct in this 6000-gal truck-and-trailer tank unit by the use of Mayari R.
Mayari R helped to reduce the deadweight of this 50-ton-capacity gooseneck trailer by 35 pct.
Built of Mayari R, this frozen-food trailer weighs 19.9 pct less than a similar unit built of carbon steel.

WHAT IS IT WORTH TO ADD 20% TO PAYLOAD CAPACITY?

How much do you think it would add to the value of a truck, trailer, or tanker to decrease its deadweight by 20 pct, and increase its carrying capacity by an equal amount?

This can be done readily, without exceeding the legal axle-load limits. And it can be done economically, by designing a vehicle to be built of Mayari R low-alloy, high-strength steel.

Yes, Mayari R does cost more than carbon steel—but it takes less of it to do the job. It can be used in thinner sections because it has a yield point almost double that of plain carbon steel, and it has from 5 to 6 times as much resistance to atmospheric corrosion. It retains paint 20 pct to 80 pct longer, depending upon the type used. Also, it can be fabricated and welded by the same methods and with the same equipment that are ordinarily used for carbon steel.

If you would like more information on the properties and advantages of this superior grade of steel, write or phone for Mayari R Catalog 259.

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Mayari R *makes it lighter...stronger...longer lasting*

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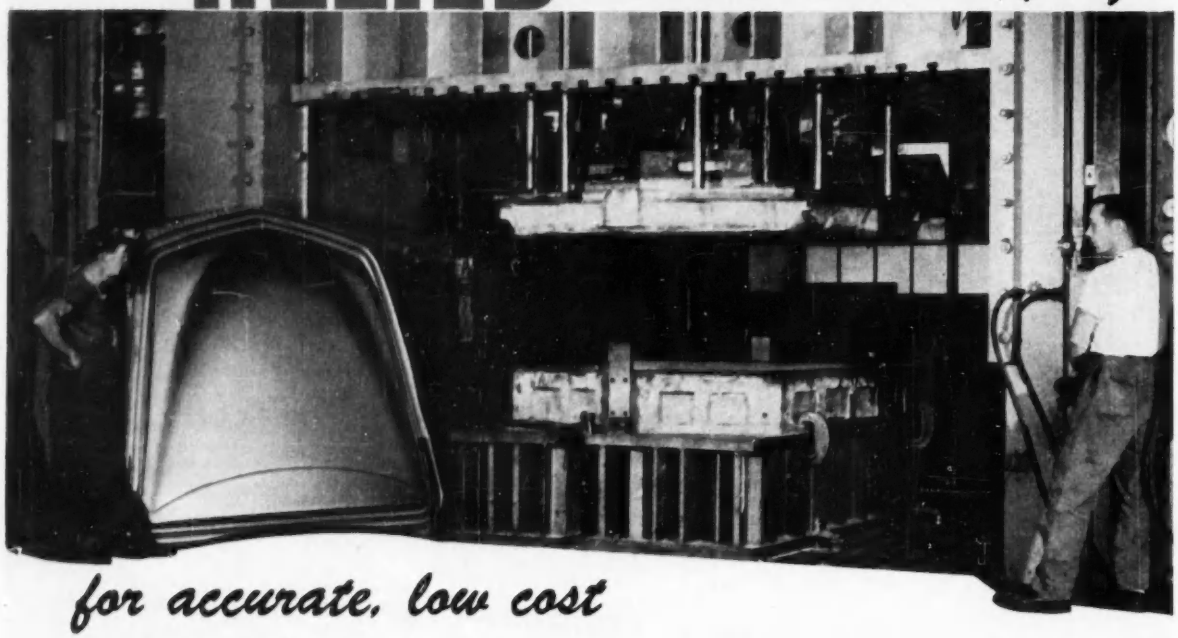
ALLIED *builds the dies... delivers the stampings*



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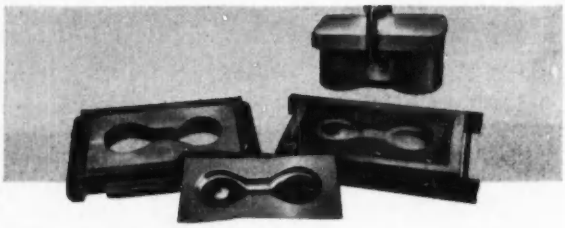
You can center *complete* responsibility with Allied's Allite Division for sheet metal stampings for prototype production . . . and save time, money and uncertainty by doing so.

For prototype production, Allied is thoroughly equipped to produce either plastic or Allite (zinc alloy) dies, depending on the physical or volume requirements of the parts. Upon completion of the draw dies, the necessary number of stampings are then produced on Allied presses and trimmed, flanged and pierced by hand and delivered ready for assembly.

When desired, the prototype dies can serve as the basis for development of production draw dies. With approval of the prototype parts, the production dies can then be built without delay or error—the true die conditions having been proved in the original, inexpensive prototype dies.

We'll be glad to show you how this unique, all-inclusive service can fit your prototype requirements. Your inquiry will receive prompt attention.



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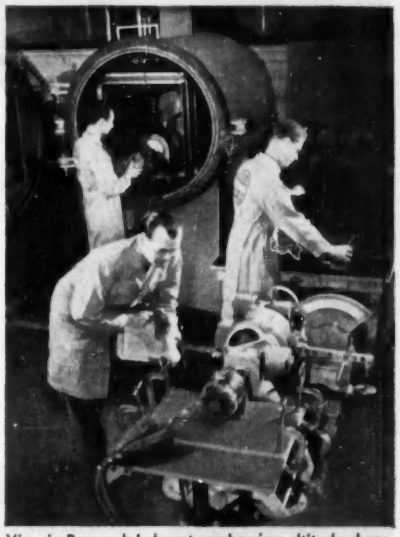
U.S. Motors' Production Testing Laboratory where aircraft motors undergo series of critical tests.



View in Research Laboratory showing altitude chamber for simulating actual operational conditions.

Building high frequency, induction type aircraft motors is no new venture for U. S. MOTORS. More than 10 years ago, U. S. MOTORS pioneered production of this new type of motor, having designed and built motors tested by the U. S. Air Force for use in planes then under development. By using experience gained in industrial motor manufacture since 1908, U. S. MOTORS was able to produce aircraft motors that were immediately acceptable by the aircraft industry. We early developed motors with increased power from reduced weight and introduced new design features that have proved most adaptable to aircraft service. As pioneers in this division of the electrical industry, U. S. MOTORS has gained know-how through endless research, testing and close cooperation with aircraft engineers and component manufacturers. This ripened experience is an asset of inestimable value to you.

Facilities for production of U. S. aircraft motors have grown to mass proportions. Each order is specially engineered to exact specifications mutually agreed upon by user and maker. As a dependable source for aircraft motors, you'll find U. S. MOTORS completely in accord with your ideas and requirements.

View of U. S. Motors' Winding Department in Aircraft Division.

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U.S. ELECTRICAL MOTORS Inc.

AIRCRAFT DIVISION

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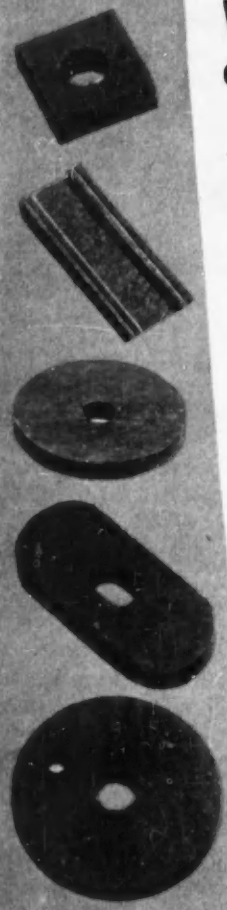

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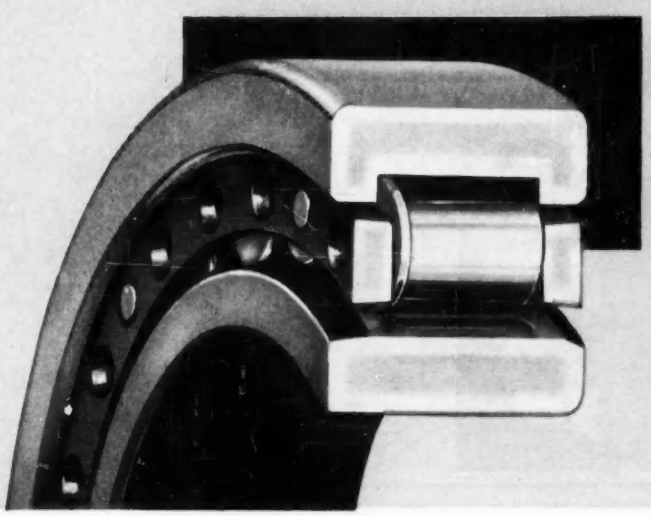
With the background of decades of experience, its makers have pioneered in modern improvements to maintain Imperial as the finest tracing cloth made.

Bower straight roller bearings carry maximum loads!



TWO-LIP RACE INCREASES RIGIDITY— IMPROVES ROLL ALIGNMENT

Examine the cutaway view of the Bower straight roller bearing, shown above. It is important to note particularly the two parallel lips made integral with the outer race. These lips or shoulders provide a rigid, durable construction—keeping the rolls in proper alignment.

Built of highest quality materials, Bower straight roller bearings have proved themselves capable of standing up day in and day out under maximum loads and the most rugged conditions—with virtually no maintenance whatsoever. They are used extensively in such fields as automotive, earthmoving, farm equipment and heavy machine tool. For the aircraft industry, Bower builds straight roller bearings—especially designed for high-speed, high-temperature operation—which are used by virtually every producer of jet engines.

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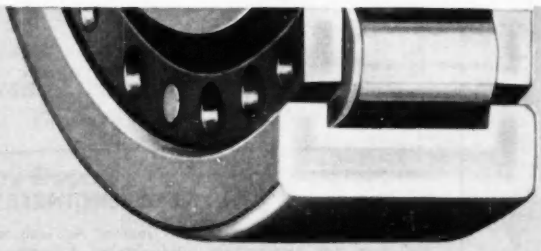
BOWER ROLLER BEARING COMPANY • DETROIT 14, MICHIGAN

BOWER

ROLLER BEARINGS



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Anchor Bushing drill templates, using sheet metal or laminate plastic materials, are made flat or in compound curved forms at a fraction of cost and time required for similar conventional drill fixtures.

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Compare your drill tooling methods, as have leading aircraft tooling departments, with the Anchor Bushing Method.

Ask today for our Anchor Bushing Catalog – it describes methods, bushing styles, sizes and prices.

Solar Aircraft Company, San Diego, craftsmen use contoured Anchor Bushing drill template on nacelle of Lockheed P2V Neptune aircraft.

Standard Anchor Bushings for rivet or spot weld attachment to sheet metal or fiberglas.

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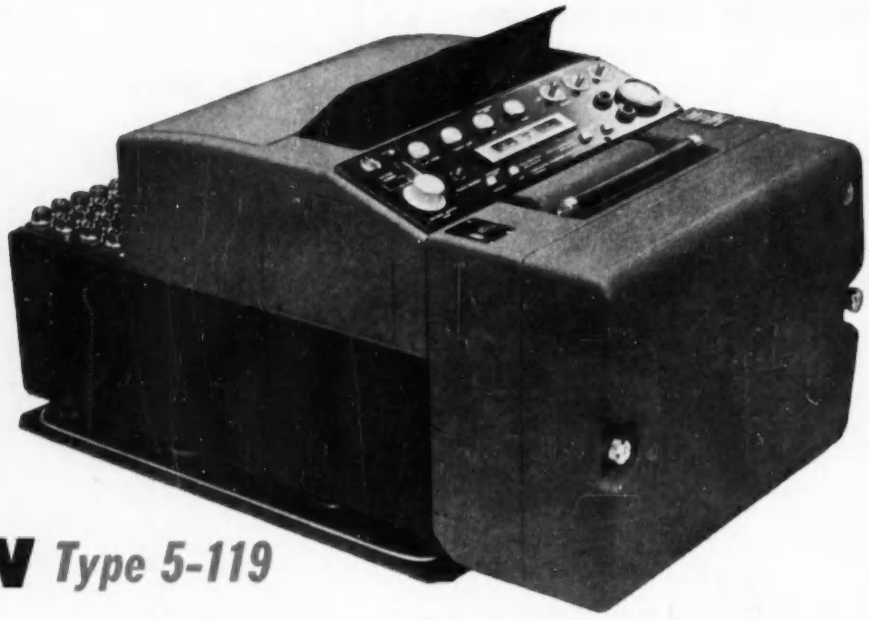
YOU *helped create this superior Recording Oscillograph*



NEW *Type 5-119*

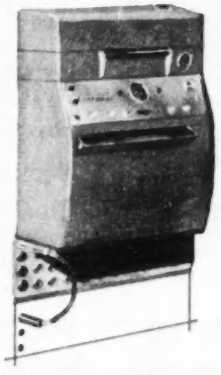
CONSOLIDATED's new Type 5-119 Oscillograph was designed and built to customer specifications. Many major users were interviewed by our design engineers to determine the features desired in a "perfect" instrument. Foremost demand was for great dependability. Second need indicated was for high trace capacity.

Dependability is achieved by extensive warning and test circuits and by reserve lamps which assure continuous recording in the event of lamp burn-out. Indicators warn immediately of any condition which could cause data loss, while additional circuits permit quick testing of the warning system. Design of the instrument assures reliable operation under the most rigorous environmental conditions.

Standard models provide either 36 or 50 traces. Consolidated's new Series 7-300 Galvanometers provide frequency response flat to 3000 cps. Standard record width of 12″ greatly simplifies record interpretation. Only after several prototypes were successfully tested under actual field conditions did we go into production on the 5-119—the new recording oscillograph leader. Write for Bulletin CEC 1536-X3.

SPECIFICATIONS

TRACE CAPACITY	36 or 50-trace models available
TRACE IDENTIFICATION	repeated, sequential trace breaks
RECORD WIDTH	12″ standard; narrower widths adaptable
RECORD MAGAZINE	removable, integral type; holds 250′ paper or film
RECORD SPEEDS	0.10 to 100 inches per sec. through quick-change gears, instantaneous switch-actuated, 10:1 speed jump
SCANNING SYSTEM	ground-glass screen and adjustable motor-driven polygon mirror; timing lines show on viewing screen
REMOTE OPERATION	accessory control unit with all essential controls & indicators
TIMING PROVISIONS	0.10 and/or 0.01 sec. lines photographed across record
EVENT NUMBERING	high-speed flash system operates as rapidly as one number per sec.
POWER REQUIREMENTS	115 volt, 60 cycle and 26 volt d-c models
INPUT PROVISIONS	all connectors on one rear deck; individual galvanometer plugs
CONTROL PANEL	all controls and indicators on single panel
ACCESSIBILITY	all adjustments can be made from one surface



The 5-119 can be panel mounted vertically with special shockmounts.

Consolidated Engineering

CORPORATION

300 North Sierra Madre Villa, Pasadena 15, California

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Recording Oscillographs

The Type 5-119 is the newest of 7 Consolidated Oscillographs ranging from 9 to 50 channel capacity. These versatile instruments simultaneously record any physical phenomena that can be transformed into electrical impulses. All measurements are obtained in clear, permanent form during the same operational cycle for future detailed analysis.

for **High Strength** and

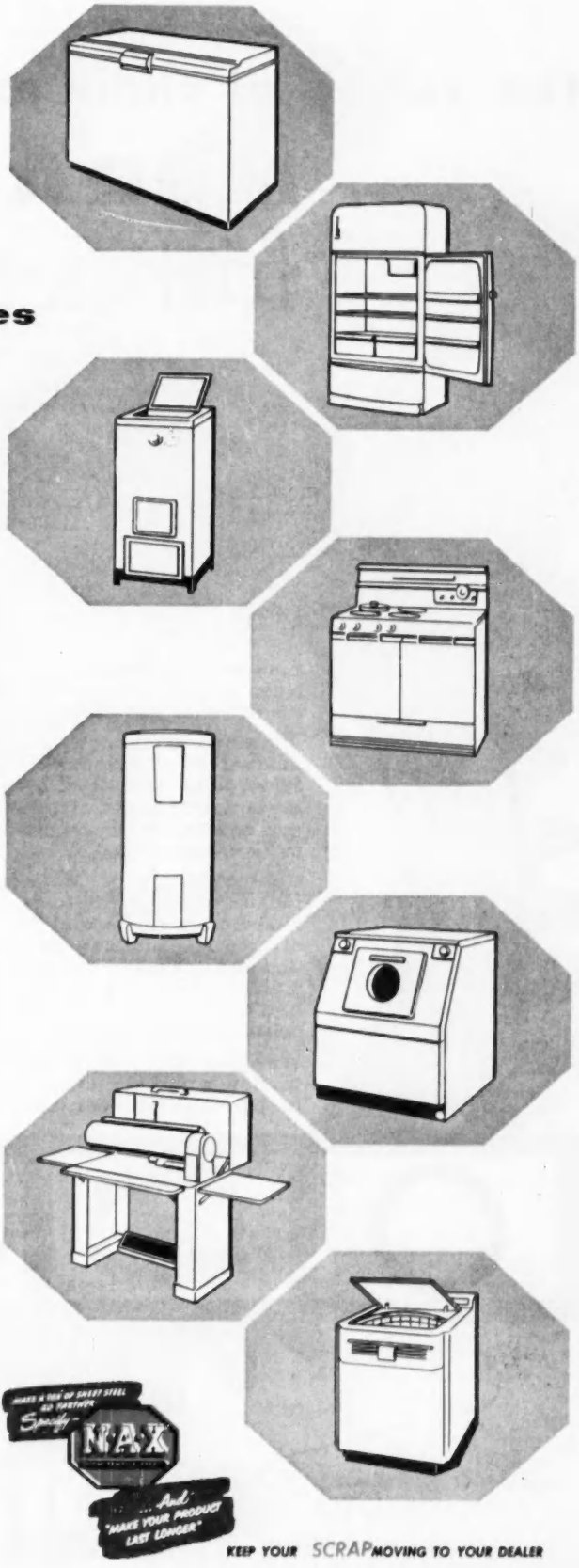
Longer Life in

Household Appliances

Specify

N-A-X

HIGH-TENSILE STEEL



N-A-X HIGH-TENSILE, having 50% greater strength than mild carbon steel, permits the use of thinner sections—resulting in lighter weight of products, yet with greater resistance to denting. It is a low-alloy steel—possessing much greater resistance to corrosion than mild carbon steel, with either painted or unpainted surfaces. Combined with this characteristic, it has high fatigue and toughness values and the abrasion resistance of a medium high carbon steel—resulting in longer life of products.

N-A-X HIGH-TENSILE, with its higher physical properties, can be readily formed into the most difficult stamped shapes, and its response to welding, by any method, is excellent. Due to its inherently fine grain and higher hardness, less surface preparation is required for either painted or plated parts.

Your product can be made lighter, resulting in shipping economies to consumer . . . to last longer . . . and in some cases be manufactured more economically, when made of N-A-X HIGH-TENSILE steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Michigan

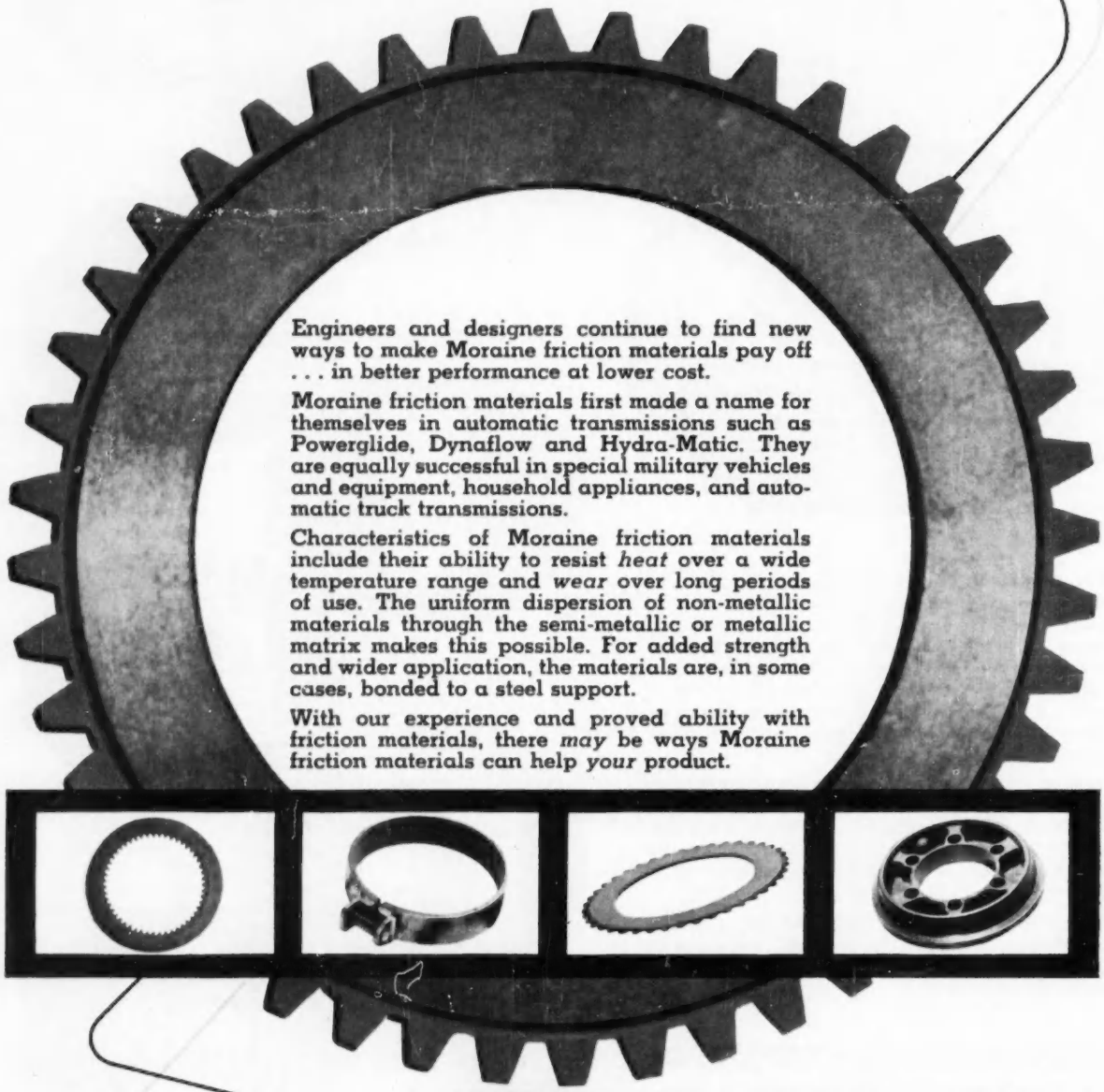
NATIONAL STEEL CORPORATION

Specify N-A-X ... And "MAKES YOUR PRODUCT LAST LONGER"

KEEP YOUR SCRAP MOVING TO YOUR DEALER

The range of their application widens!

MORAINE friction materials



Engineers and designers continue to find new ways to make Moraine friction materials pay off . . . in better performance at lower cost.

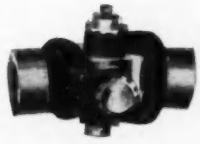
Moraine friction materials first made a name for themselves in automatic transmissions such as Powerglide, Dynaflow and Hydra-Matic. They are equally successful in special military vehicles and equipment, household appliances, and automatic truck transmissions.

Characteristics of Moraine friction materials include their ability to resist *heat* over a wide temperature range and *wear* over long periods of use. The uniform dispersion of non-metallic materials through the semi-metallic or metallic matrix makes this possible. For added strength and wider application, the materials are, in some cases, bonded to a steel support.

With our experience and proved ability with friction materials, there *may* be ways Moraine friction materials can help *your* product.

m moraine products

DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO



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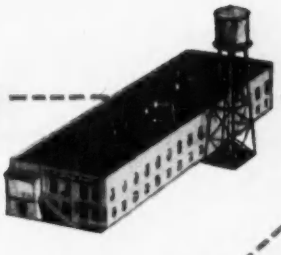

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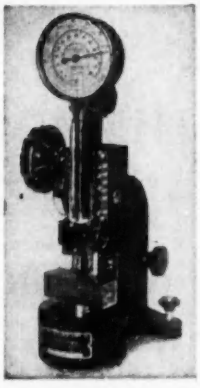

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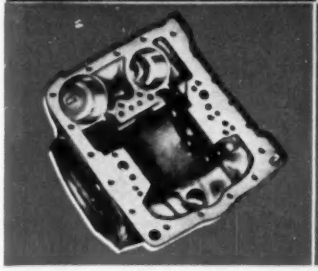
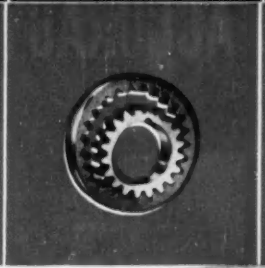
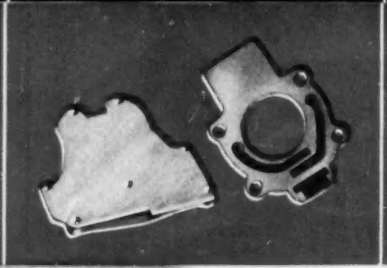
TRANSMISSION CASE (CAST IRON) THREE TYPE I, ONE TYPE III SURFACES



PUMP GEARS (CAST IRON; STEEL) SIDE SURFACES, TYPE IV



TRANSMISSION COVER AND GOVERNOR BODY (BOTH ALUMINUM) TYPE III SURFACES



PINION GEARS (HARDENED STEEL) THREE TYPE II, TWO TYPE IV SURFACES

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Microhoning maintains concentricity of pitch diameter of teeth and the bore of gears, permitting teeth to mesh with minimum noise and wear. The bore must have precise geometry, size, and functional finish to retain a lubricating film at high speed.

Type III—Flat surfaces that are bolted together without a gasket.

They must be flat enough so that they will not distort when pulled together, and must have a surface finish that will mate to form a tight, effective seal.

Type IV—Flat surfaces that move in contact with stationary surfaces.

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For more information on the Microhoning process write to:
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Micromatic Hone Corporation
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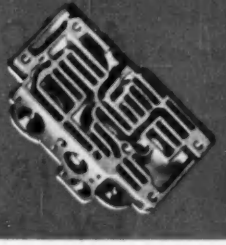
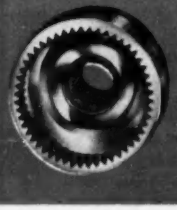
Detroit 38, Michigan

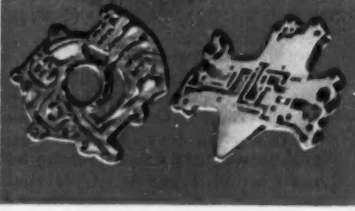
VALVE BODY (ALUMINUM) TWO TYPE III, ONE TYPE I SURFACES



KICK-DOWN GEARS (STEEL) TYPE IV SURFACES



TRANSFER PLATE AND REGULATOR BODY (BOTH STEEL) TYPE III SURFACES



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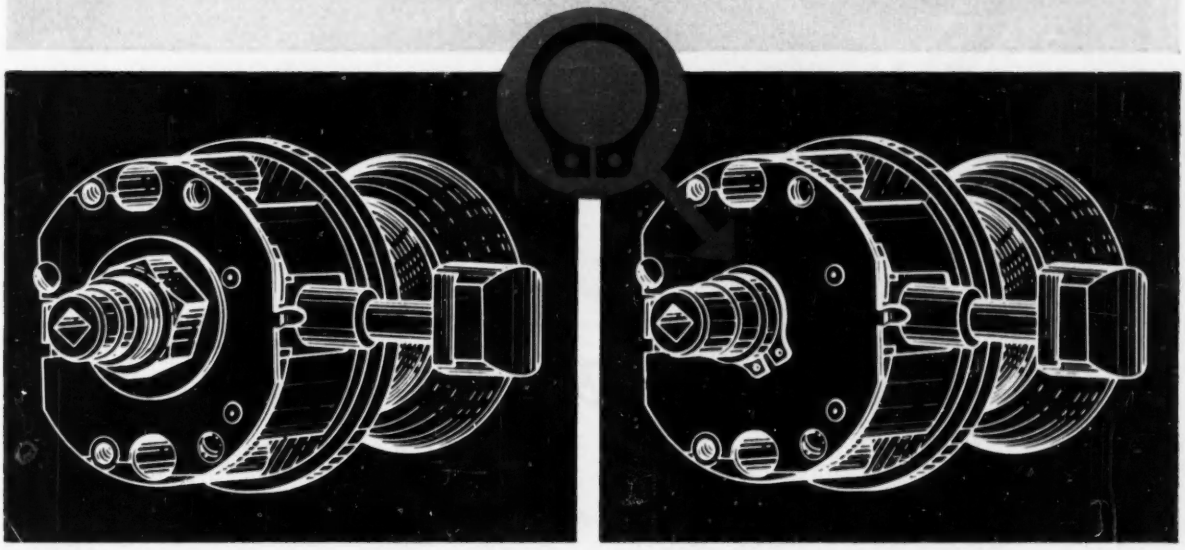

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Cost of Truarc Ring and Grooving Operation	$11.52	*per thousand*
Assembly	2.00	" "
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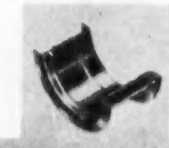

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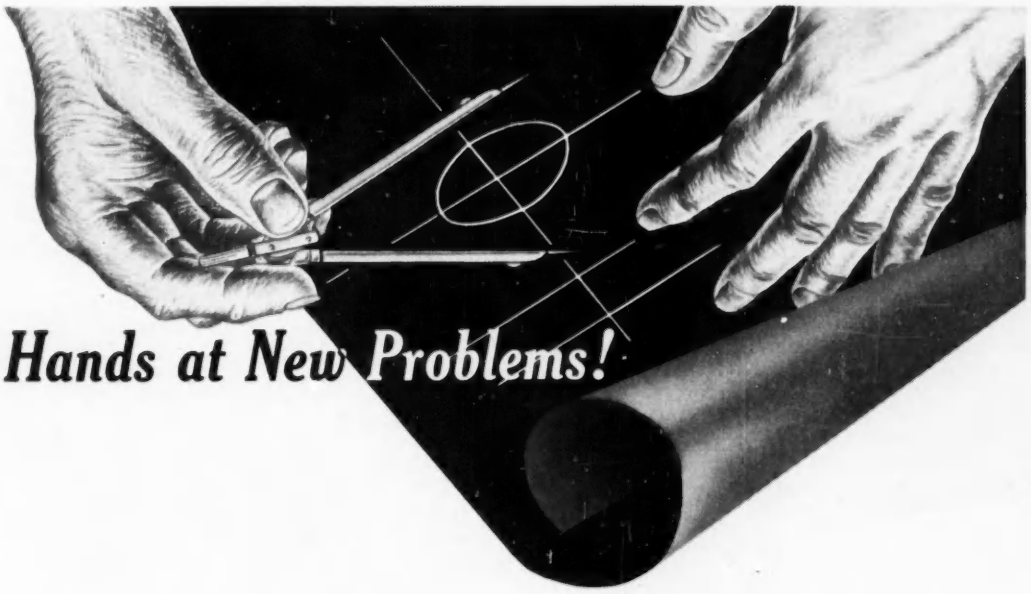

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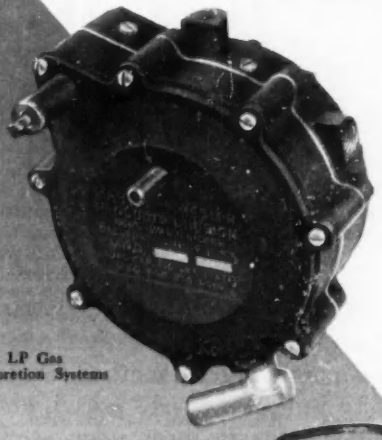

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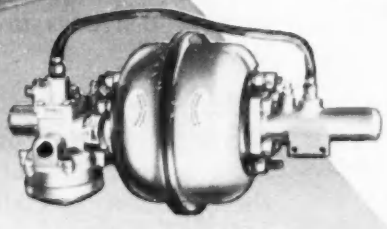

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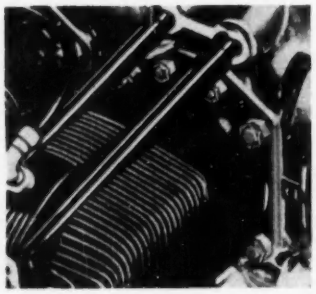

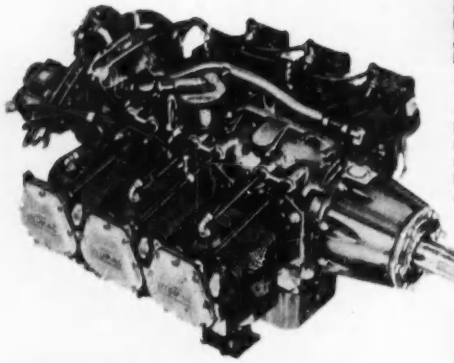

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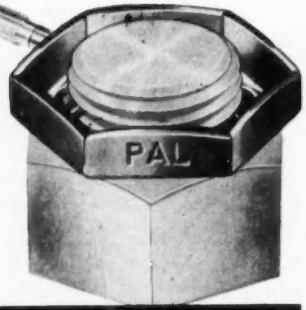

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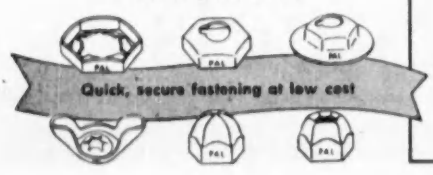

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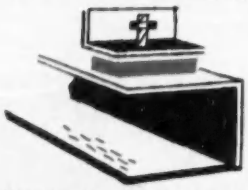
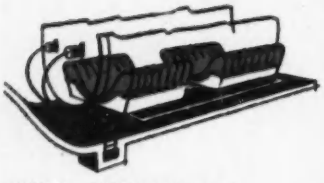
FELT for GASKETS (1)

There has to be a seal between the lid and body of electric power transformers, to exclude dirt and moisture, hold in the oil that insulates and cools. Felt is widely used for this purpose.



FELT absorbs VIBRATION (2)

To isolate spring-suspended gasoline tanks from the chassis of trucks and absorb road shocks and weaving strains, felt pads are used. These give enough to protect the tanks, but not enough to disturb gas lines.



FELT for LUBRICATION (3)

Many locomotive journals are lubricated by felt, cut to fit the hub. Pumped oil is fed evenly, waste-grabbing eliminated. Length of life of the felt is estimated at 75,000 to 100,000 miles of perfect lubrication.

FELT for POLISHING (4)

The final polishing operation on steel cutlery changes the finish from dull to bright. About .002" of steel is removed by felt polishing discs, fed with fine pumice. The discs are slotted for flexibility.

FELT in REFRIGERATION (5)

In refrigerators and air conditioners there is usually a cartridge filled with a dehydrating agent. Felt is used as a filter to prevent small particles of the drying crystals being carried into the refrigerant line.

GET THE FACTS ABOUT

FELT

AND WHAT IT CAN DO FOR YOU

These are just a few of the many applications of felt in plants and products. Remember that felt is an engineering material, which can be specified as closely as any other. American makes felts as soft as a kitten's ear, or hard as a board, and many other types as well, including OilFoil seals, laminations of synthetic rubber and felt. We also cut felt parts in many shapes, designs and sizes to your blueprints. The Engineering and Research Laboratory will gladly collaborate with you on the selection of the correct felt for maximum economy and satisfaction. Mail the coupon below for further information.

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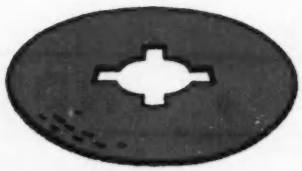
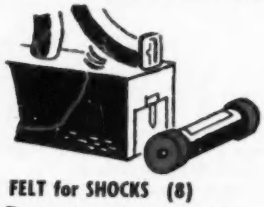


FELT CLUTCH FACING (6)

Industrial sewing machines have a clutch, which must take hold quickly, yet smoothly and firmly. These clutches operate properly when faced with felt discs cut to size and shape. This is a frictional application of felt.

FELT for HONING (7)

The cylinders of internal combustion engines are finished by honing. The honing head carries abrasive stones alternated with strips of felt, the latter greatly improving the quality of the surface obtained.



FELT for SHOCKS (8)

Pneumatic carriers of both large and small sizes are in wide use. American supplies special felts for them. One type is used as a bumper head on the carrier to absorb shock on delivery; another is an air-pressure seal.

FELT for FIRE EXTINGUISHERS (9)

Hand-pumped fire extinguishers use felt washers for lubrication, for holding compression, as a bumper for the upstroke, and as a cushion for the nozzle. American also supplies flame-proofed felt for airplanes, theatres, etc.

AMERICAN FELT COMPANY
P. O. Box 5, Glenville, Conn.

1 2 3 4 5 6 7 8 9

Please send me further information about the application circled above.

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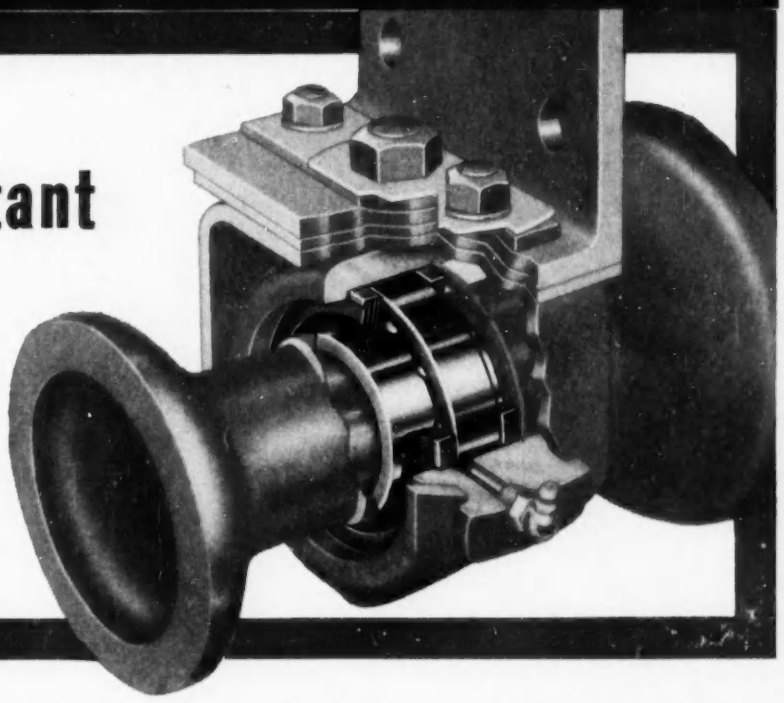
An important role in low-cost disking



On John Deere-Killefer disk harrows, Fafnir Wide Inner Ring Ball Bearings are playing an important role in the achievement of low-cost, trouble-free disking operations. Besides reducing friction with a resultant extension of service life, these bearings make possible a more compact housing which provides extra clearance below the spools to allow dirt, trash and cover crops to pass through without dragging on the bearing. They put lubrication on a once-a-season basis . . . equipment is ready to use instantly. Their rugged construction withstands greater shock loads. Triple seals make them impervious to dirt and moisture.

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